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DEMOGRAPHIC CHANGE AND THE ECONOMY OF THE NINETIES

REPORT

PREPARED FOR THE

SUBCOMMITTEE ON TECHNOLOGY
AND NATIONAL SECURITY

OF THE

JOINT ECONOMIC COMMITTEE
CONGRESS OF THE UNITED STATES

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LETTER OF TRANSMITTAL

OCTOBER 16, 1991

Hon. PAUL S. SARBANES
Chairman, Joint Economic Committee
Congress of the United States
Washington, D.C.

Dear MR. CHAIRMAN: I transmit herewith a study entitled, *Demographic Change and the Economy of the Nineties,* for the use of the Joint Economic Committee, members of Congress, and the interested public.

The study comprises a series of essays examining the consequences of demographic change on the labor force, manufacturing, housing, transportation, and other sectors of the economy. A major conclusion of the study is that there will be slow growth of the gross national product in the 1990s unless the expected slowdown in the growth of the labor force is fully offset by faster growth of productivity, and that this will require greater investment in productivity-enhancing equipment and technologies.

The essays were prepared by specialists in the Congressional Research Service. William Cox served as coordinator and wrote the overview and two of the essays. Other contributors were Claudia Copeland, Jeff Hornbeck, Barbara L. Miles, Linda Levine, and Jennifer D. Williams. We are grateful to the Congressional Research Service for making available Dr. Cox and the other contributors to work on the project. Richard F Kaufman, General Counsel of the Joint Economic Committee, served as supervisor for the committee and prepared the Executive Summary.

The views and conclusions contained in the volume are those of the authors and not necessarily those of the Subcommittee on Technology and National Security, or individual members.

Sincerely,

JEFF BINGAMAN,
Chairman,
Subcommittee on Technology and National Security.

LETTER OF SUBMITTAL

THE LIBRARY OF CONGRESS,
CONGRESSIONAL RESEARCH SERVICE,
Washington, D.C., October 12, 1991.

Hon. JEFF BINGAMAN
Chairman, Subcommittee on Technology and National Security
Joint Economic Committee
Congress of the United States
Washington, D.C.

DEAR MR. CHAIRMAN: As Chairman of the Subcommittee on Technology and National Security, you requested that the Congressional Research Service (CRS) project the effects of dramatic demographic changes on the U.S. economy in the 1990s. The resulting studies, submitted herewith, deal with their implications for labor markets, manufacturing, housing, commercial and industrial construction, and infrastructure requirements during this decade and into the early 21st century. This volume is intended to give Members of Congress a panoramic view of developments that may fundamentally alter many social and economic problems and the possible options for dealing with them. The principal results of this work are distilled in the section entitled, "Overview," and in an "Executive Summary," prepared in collaboration with the Committee's staff.

All contributors to this volume are CRS employees. They are:

- William Cox, senior specialist in economic policy in the Office of Research Coordination, who coordinated the project and wrote the overview as well as the chapters on manufacturing and on private nonresidential construction;
- Jennifer D. Williams, analyst in demography in the Government Division, who authored the chapter on patterns of demographic change, historical and projected, for the period 1970 through 2010;
- Linda Levine, specialist in labor economics in the Economics Division, who wrote on projected interactions between demographic change, labor markets and potential labor policies in the 1990s;
- Barbara L. Miles, specialist in housing in the Economics Division, who wrote the chapter on housing demand, homebuilding and home prices;
- Jeff Hornbeck, economic analyst in the Economics Division, who wrote on the need for transportation infrastructure in response to projected demand for road and air transportation; and

- Claudia Copeland, specialist in environmental policy of the Environment and Natural Resources Policy Division, who authored the chapter on wastewater and water-supply infrastructure.

We hope that these studies will serve the needs of your subcommittee as well as those of other committees and Members of Congress concerned with the future of the U.S. economy and with economic policy.

Sincerely,

JOSEPH E. ROSS
Director.

DEMOGRAPHIC CHANGE AND THE ECONOMY OF THE NINETIES

EXECUTIVE SUMMARY

Demographic trends are profoundly altering the American economy. Shock waves of change are starting to be felt in basic economic sectors, such as manufacturing and construction, as population growth slows, and the pattern of growth shifts among age groups. In the next several years, many fundamental assumptions about economic performance will have to be changed. For example, slower growth of the labor force implies lower limits on the Nation's long-term potential for economic growth.

Population growth averaged about 10 percent in each of the past 2 decades. For the 1990s and the first decade of the 21st century, population growth is projected to slow to 7 percent and then 5 percent. The labor force increased at an annual rate of 2.6 percent in the 1970s and 1.6 percent from 1980 to 1988. From 1988 to 2000 the growth is projected to slow to 1.2 percent.

One of the most dramatic demographic changes in the next 20 years will be large increases in numbers of middle-aged people, 45 to 64, and declines in numbers of young adults, 25 to 44. The aging of the population means that the population "pyramid" is turning upside down, with more people in the older age groups.

Macroeconomic Effects

Two key questions are whether slower labor-force growth will retard expansion of the economy and hamper improvements in living standards. The growth of GNP will be slowed unless the labor force slowdown is fully offset by faster growth of labor productivity. However, real earnings per hour (a proxy for living standards) can increase if there is substantial acceleration in productivity growth, even if the economy grows slowly.

Productivity will be influenced by a number of factors. Slower labor-force growth probably means tighter labor markets in rapidly growing industries, occupations, and regions. This could lead to greater investment in labor-saving (productivity-enhancing) equipment and technologies. As the work force ages the average worker should have more experience and more regular work habits.

On the other hand, in a tight labor market, it may become necessary for employers to lower hiring standards in order to obtain entry level workers, and to provide more training and supervision. Such requirements can impede productivity growth. Also, as the work force ages, it may become less adaptable and less ready to retrain for new technologies, to change occupations, or to move to new locations.

Labor Market

In addition to a scarcity of entry level workers, members of the "baby boom" generation will swell the ranks of middle-aged employees and encounter intense competition on narrowing ladders of promotion opportunity. The congestion is likely to hold down average pay and promotions. The effects of career frustration on the morale and productivity of middle-aged workers may be far reaching and may have negative consequences for productivity.

Women are expected to constitute some 60 percent of the net additions to the work force in the 1990s (that is, after retirees and other leavers are excluded). This highlights the need to enhance the productive potential of female workers. Among the possibilities for achieving that result are elimination of sex stereotyping and other discrimination in the work place, better child and elder care programs, and more flexible work hours.

Black and Hispanic workers are projected to make up more than 40 percent of the net additions to the work force. Partly because of immigration, Hispanics alone could account for 25 percent. To enhance the potential of these workers, assistance will be needed in some cases to offset insufficient education, English language skills, and job experience. Employers will need to provide extra training, counseling, and other support to such workers.

Manufacturing

U.S. manufacturing has been weakened by several developments in the past 20 years, including the rise in energy prices in the 1970s, the increase in the dollar's exchange rate in the 1980s, and the decline in international competitiveness of a number of industries. Although some of these challenges have been reversed, demographic change represents a new threat to some sectors.

Slower growth of the population and labor force will seriously affect the construction industries and manufacturers of durable goods. Purchases of building materials and installations are expected to grow very slowly, if at all, during the 1990s. Purchases of consumer durable goods will grow much more slowly than in the 1970s and 1980s, especially those of motor vehicles and parts and household furnishings. The fastest growth among consumer goods is projected for electronic products but a large share of these is presently imported.

Cuts in military procurement will also affect manufacturing. However, these effects should not be exaggerated. A 25-percent reduction in the real purchasing power of the military budget over 5 years would reduce total output of the durable goods industries by less than 1 percent per year. The consequences for certain firms and communities heavily dependent on defense purchases will be greater.

The prosperity of manufacturing in the 1990s will depend greatly on improvements in the balance of trade and modernization and replacement of the nations's infrastructure. U.S. exports and import-competing goods should continue to regain market share, assuming macroeconomic policies do not distort the dollar's exchange rate, and trade policies help make it possible for American firms to take advantage of opportunities abroad. American capital goods and

technical expertise can play major roles in the reconstruction of Eastern Europe, the Soviet Union, and the Middle East. The backlog of needs for infrastructure investment in the United States can help sustain demand for manufactures, if the appropriate government programs are put in place.

But these sources of growth in manufacturing are limited and temporary. Prospects for the longer term will be determined largely by our response to challenges of leading-edge technologies. The 1990s should be seen as a time for further economic development, technological advances, and commercialization of new technologies that can provide manufacturing jobs, incomes, and exports into the next century.

Homebuilding and Housing Prices

It is projected that an average of 1.3 to 1.5 million new housing units (including mobile homes) will be built annually in the 1990s, compared to about 1.75 million in the 1980s and nearly 2 million in the 1970s. This will be a negative influence on residential construction industries and the demand for household furnishings. Because new units will tend to be larger and more expensive, on average, the value of home construction may not decline.

This study disputes forecasts of severe declines in housing prices. The demand for higher-priced housing will increase as the baby boomers age, although the trend will be moderated by the fact that the baby boomers will be less successful in their quest for higher incomes than earlier generations. At the same time, prices will sag for small and lower-quality dwellings, occupied mainly by young people and others with low incomes.

The future strength of housing and the prices of other assets will be closely related to future interest rates. Prospective home buyers are greatly influenced by mortgage finance costs. If inflation is moderate and interest rates are allowed to subside, housing prices could rise faster than other prices.

Nonresidential Construction

Office and commercial construction soared in the 1980s, when the nation's supply of office and shopping space nearly doubled. The construction boom occurred largely because of the generous depreciation allowances provided in the tax reduction act of 1981. Deregulation of the thrift institutions also encouraged lenders to make loans on nonresidential projects despite rising vacancy rates.

Commercial real estate now faces a prolonged depression while the present high vacancy rates come down. It is likely to take several years for vacancy rates to come down to healthy levels. Because of demographic trends, the need for new structures will grow more slowly than in the past. Hence, office and commercial construction may never regain the levels reached in the 1980s.

Building for manufacturing and utilities, which slumped in the 1980s, could increase over the next several years. After the year 2000, the demographic slowdown is likely to reduce the need for most types of construction.

INFRASTRUCTURE

The demographic trends that caused higher automobile travel and traffic congestion are not expected to continue at the same rates as during the past two decades. But growth at lower rates in car ownership, freight movement, and commuter traffic will still strain highway capacities. There is also a backlog of highway and bridge deficiencies as a result of the aging interstate highway system and the tendency of all levels of government to defer maintenance and replacement. New construction and maintenance will be required to meet previous as well as future growth in travel demand.

Demand for air transportation services has grown at a rapid rate, in part because of airline deregulation and reduced prices, and is forecast to grow at nearly 3 times the expected growth of the national population. But capacity constraints already limit growth at many of the heavily used airports. Unless public policy permits construction of new airports and expansion of the existing ones, it may not be possible for them to meet future demand for air travel.

Because water and wastewater treatment requirements are sensitive to the size of the population served, and the population is declining in some states and growing in others, user demands and needs for new investment vary greatly among regions and localities. Yet, current Federal policies state that aid programs should support wastewater needs of existing populations, not economic development or population growth needs. The current allotment formula bears little relationship to either existing or projected future requirements. In addition, Federal assistance under the Clean Water Act is scheduled to end after 1994.

A 1988 report of the Environmental Protection Agency indicates that the States have a backlog of wastewater treatment plant needs of $68 billion, plus $15 billion to meet the needs of projected population changes to the year 2008. Many communities are still struggling to bring their systems up to the standards required by law. Given the financial constraints on the States, if Federal support is discontinued, it is unlikely that the investment needs will be met within that time.

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I. OVERVIEW

By William A. Cox *

Demographic change comes by stealth. Not that it's secret or hidden. It is there for all who look at the figures to see. But it happens quietly and gradually. Many people who should be concerned don't recognize important demographic developments in the making because their attention is diverted by more dramatic movers. Many don't notice because they are concerned only with the short term, not with the longer run, and demographic change usually works its effects over longer periods. But the effects of demographic change now occurring in the United States will play dominant roles in many parts of the economy in the long run.

In the labor market, for instance, growth of the work-age population in the United States slowed markedly around 1980, as the baby-bust generation followed the baby boomers into the work place. But unemployment was 7 percent in 1980 and rose to more than 10 percent by 1982–83 as the deepest recession since World War II took its toll. As the economy recovered, job creation returned to the high rates of the 1970s, even though labor-force growth had slowed, because high unemployment could be drawn down, and improving conditions drew discouraged job seekers back into the market. The economy created more than 15 million jobs from 1982 through 1988 even though the labor force grew by only 11.5 million. The impact of the demographic slowdown appeared to be deferred.

But now it has to be confronted. Unemployment in 1989 was only 5.2 percent, and the increase in labor compensation began to accelerate, a sign that employment no longer could grow faster than the labor force without rising inflation. In the recession that began in 1990, unemployment rose more slowly than in previous recessions of the past 20 years, because labor-force growth is slower, and unemployment is likely to decline faster in the recovery. Real gross national product (GNP) grew at a compound annual rate of 3.8 percent from 1982 to 1989, but this rate of growth is unlikely to be possible on a sustained basis in the future because of the limited supply of labor. Labor surplus, which has prevailed widely since 1970, may turn into recurrent scarcity.

The growth of highway traffic, as another example, also is projected to slow by roughly one-third in the period, 1988 to 2005, from the preceding 21 years. But the need for roadbuilding may not decline soon because of a backlog of improvements and repairs needed already. Even higher roadbuilding outlays may be required in the 1990s. Sooner or later, however, if construction continues at

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today's rate, the deficiencies will be reduced, and the need for further roadbuilding will decline. If not in this decade, then after the turn of the century.

Demography is altering many of the parameters of the U.S. economy. Because it is stealthy, this attempt to foresee its implications for important sectors has been undertaken to help policy makers to avoid grappling with yesteryear's problems and adopting policies that aggravate tomorrow's.

Demographic Change in the 1990s and Beyond

In Section II of this volume, Jennifer Williams, analyst in demography in the Government Division of the Congressional Research Service, summarizes demographic developments in the United States, its regions, divisions and States since 1970 and the Census Bureau's middle projections of U.S. population through 2010. (For definitions of the Census Bureau's regions and "divisions," see Figure 1 in Section II of this report.)

Total U.S. population increased slightly more than 10 percent in the 1970s and slightly less in the 1980s. Most of this growth occurred in the South and West. Population in the West grew at more than twice the national rate, while in the South it grew by 20 and 13 percent in the two decades respectively. These two regions together accounted for about nine-tenths of the country's population growth in each decade. The top ten States in percentage gains, except for New Hampshire, were in these regions.

Jennifer Williams points out that these gains occurred mainly in the Southeastern, Southwestern and Pacific States. Population in the South Atlantic States—Delaware to Florida—grew by 18 percent in the 1980s. Three States—California, Florida and Texas—accounted for more than half of total U.S. population growth. The northern Rocky Mountain States, on the other hand, had very small gains and, in the case of Wyoming, a loss of people. States of the East South Central and West South Central census divisions (except for Texas) saw small increases.

Modest population growth or losses in the Midwest and Northeast contrasted with rapid growth in the South and West and held the national figures to their moderate increases. Population in the Midwest region grew by only 1 percent in the entire 1980s. Minnesota led with 7-percent growth, followed by Kansas, Missouri and Wisconsin. Population of Illinois, Michigan, Indiana and Ohio—"the industrial heartland"—was virtually unchanged. Other Plains States grew very slowly and, in the cases of Iowa and North Dakota, sustained losses. The Northeast region's population was static in the 1970s but, with better economic times, grew by 3 percent in the 1980s. New Hampshire grew by 20 percent in the 1980s, and other New England States by 5 percent or more. Percentage growth for the entire Northeast was held down by much slower gains in populous New York (2.5 percent) and Pennsylvania (0.2 percent).

Migration, both among regions and from abroad, is important in explaining these growth contrasts, according to Williams. The two fast-growing regions received heavy net in-migration. Net migration into California, Florida and Texas—the fastest-growing States

in absolute numbers—accounted for 54, 88 and 43 percent respectively of the increase from 1980 to 1988! (Migration data from the 1990 census are not yet available.) The States that lost population during this period—Iowa, Michigan and West Virginia—experienced net out-migration that exceeded their natural population growth. Twenty other States also had net out-migration, including New York, Pennsylvania, all of the Great Lakes States, most Plains States, the northern Rocky Mountain States and others.

The South and West received net in-migration from 1980 to 1988 of 6 and 8 percent of their respective starting populations, Williams reports. Much of the South's migration gain was in Florida, Texas and Georgia, while most migrants to the West went to California, Arizona and Washington.

In the Midwest, on the other hand, net out-migration from 1980 to 1988 equaled 4 percent of the 1980 population, and every midwestern State except Missouri experienced migration losses. Michigan, Illinois and Ohio led in absolute losses, and Iowa and North Dakota had sizeable percentage declines. These losses were spurred at least partly by poor economic conditions in manufacturing and agriculture due in some measure to the dollar's very high exchange rate and the resulting large trade deficits of the period. These factors are now being reversed. The Northeast had slight migration losses because of net outbound movements from New York, Pennsylvania and Massachusetts, offset in part by gains in the other northeastern States.

For the 1990s and the first decade of the 21st century, national population growth is projected in the Census Bureau's middle scenario to slow to only 7 percent and 5 percent respectively from about 10 percent in the past two decades. Population in the West and South would increase considerably more slowly than before, while gains in the Northeast would be small, and the Midwest would see a slight overall population decline. The South would widen its lead as the Nation's most populous region. The West would move from fourth to second place, and the Midwest and Northeast would slip to third and fourth respectively.

California would remain the largest State in population. Texas would edge out New York for second place, and Florida would remain fourth. By 2010 California, Florida and Texas are projected to have 27 percent of all the people in the United States. States projected to have the largest losses from 1990 to 2010 are located chiefly in the Midwest and Northeast regions with sizeable percentage declines expected also in West Virginia. These projected patterns could be changed by significant shifts in the economic fortunes of different regions stemming from major changes in energy prices, trade balances, or other factors.

Jennifer Williams points out that international migration (immigration) will play an increasingly important role in population growth patterns as indigenous growth slows. The Census Bureau in 1989 projected that immigration would contribute 30 percent of total growth in the 1990s and 35 percent in the following decade, and increases in legal immigration, such as those approved in 1990, will make this share somewhat greater. Given projected out-migration of indigenous population from the Northeast and Midwest, only immigration can prevent net migration losses in these regions,

and it may be insufficient to do so, especially in the Midwest, which receives relatively little influx from abroad.

Regions receiving migrants will draw them from other regions of the United States as well as from foreign countries. The South is expected to receive most of its migrants from other parts of the United States, while the West should gain more from abroad. Migration from other States is projected to account for more than 40 percent of the South's population growth in the 1990s, and immigration for almost 13 percent more. Migration from other States would provide 13 percent of the West's growth, and that from abroad for 31 percent. The percentages are smaller in the West in large part because its existing population, augmented by heavy inmigration in the recent past, is younger and thus has a higher rate of natural increase. After 2000 migration is projected to continue supplying large shares of population growth in these regions.

By 1995 Florida's growth could depend wholly on migration as its deaths begin to exceed births. Florida is unique in its exceptionally large concentration of elderly people. However, 68 percent of Arizona's growth in the 1990s is projected to come from net migration; 70 percent of Nevada's; 69 percent of Hawaii's; and 62 percent of Georgia's. After 2010, as the baby-boom generation moves into old age, various States may see an excess of deaths over births.

In addition to slower overall population growth, changes in the age distribution of Americans over the next two decades will affect the U.S. economy dramatically. These changes are already predetermined in large part by the drop in births that occurred after 1964 and continued until the late 1970s. Although immigrants are younger on average than the U.S. population as a whole, their impact on the national age distribution is diffuse, says Williams. It is significant for the labor force, however, that immigrants are relatively concentrated in the younger working ages. Half of all legal immigrants in 1989 were between 15 and 34 years old, while only one-third of the U.S. population was in that age bracket. Changes in birth rates that occur presently or in the future, however, will have no effect on the size and composition of the *adult* population within the twenty-year horizon of this analysis.

Successive declines in births until the late 1970s resulted first in shrinking numbers of pre-school and then of school-age children. These were followed from 1980 to 1988 by an 11-percent drop in the number of young adults of ages 18 to 24. The age group from 25 through 44 years old grew rapidly during this period as the maturing of the baby-boom generation raised its numbers by 26 percent. Now, however, the youngest baby-boomers are nearing 30 years old and the oldest are already 45, and the earlier growth of 25-through-44-year-olds is turning into a marked decline, as large cohorts move on and smaller ones follow. As spelled out in detail in other sections of this report, this turnabout has dramatic implications for labor markets, housing markets, nonresidential construction and even manufacturing.

Population between 45 and 64, by contrast, increased by only 3 percent from 1980 to 1988 but is now entering a period of dramatic growth, as the leading edge of the baby-boom generation moves into middle age. The number of people 65 and over grew by 19 per-

cent, as increasing numbers reaching 65 were augmented by increases in longevity.

At the regional level, says Jennifer Williams, net migration plays a more important role in determining the population's age distribution than for the Nation as a whole. States of the Southeast, Southwest and Pacific areas tend to have more young adults and children because they receive the bulk of the migrants. Net out-migration has the opposite impact on the Midwest and Northeast. Fast-growing States tend to have higher fertility and lower mortality than those with steady out-migration, because of the high concentration of younger persons among migrants.

Every State in the Union except Alaska, Arizona, Florida, Nevada and New Hampshire shared in the decline in numbers of young adults (18 through 24 years old) from 1980 to 1988, Williams reports. The drop was greatest in the Midwest (18 percent) and smallest in the South (7 percent). All States gained population between 25 and 44 years of age with the fastest growth in the West (35 percent) and the slowest in the Midwest (19 percent). This group grew by one-third or more in 11 States including eight in the West plus Florida, Texas and New Hampshire.

Older work-age adults (45 through 64) declined by 2 percent in the Midwest and Northeast during this period and increased by 10 and 8 percent in the West and South respectively. All Midwestern States except Minnesota and Missouri lost people in this age bracket, as did Connecticut, Massachusetts, New York, Pennsylvania and Rhode Island. Although this Overview emphasizes information on the work-age population, corresponding data on children and elderly people are found in Jennifer Williams' contribution, which follows.

In the twenty years, 1990 to 2010, projected low fertility and the aging of the baby boom are expected to increase the median age of the U.S. population from 33 to 38.9 years, according to the Census Bureau's middle projections. The preschool population would decline by about 8 percent over these twenty years. The school-age population (through 17) would grow somewhat in the 1990s and drop back after 2000. The population of adults between 25 and 44 will contract nationally as the aging baby boom expands the middle-aged population, 45 through 64, by large amounts, projected in the middle scenario at 68 percent (from 47 to 79 million). The elderly population is projected to increase by about 25 percent—more slowly than in the past—because the small cohorts born during the Great Depression of the 1930s will soon be reaching the age of 65. After 2010, when the oldest baby boomers reach 65, the elderly population will mushroom, causing much discussed problems for health and retirement systems.

Viewing the projections in regional terms, the school-age population would increase in every part of the country during the 1990s and decrease in the following decade. The Midwest would have by far the smallest gain followed by the greatest loss. The number of young adults is expected to increase only in the West in the 1990s (by 7 percent), because in-migration of such people is projected to outweigh the aging of the pre-existing population. Between 2000 and 2010 all regions should see moderate gains in this age bracket. Decreases in population, 25 through 34, are foreseen for all regions

over these 20 years, except for a modest comeback in the South and West after 2000; and decreases among 35-to-44-year-olds are expected in every region from 2000 to 2010 as the baby boomers pass out of this age bracket, and smaller cohorts follow them in.

The biggest demographic development in the next 20 years will be the pronounced growth in numbers of middle-aged people (45 to 64) in all parts of the country. This group could expand by more than 90 percent in the West and 80 percent in the South. This dramatic change will make waves in the work place as well as in markets for housing and other goods and services.

Jennifer Williams emphasizes that population projections are only as good as the assumptions underlying them. Their derivation is spelled out in detail in Section II of this report. In particular, the projections assume continuing low fertility—a total fertility rate of about 1.8 children per woman over her lifetime. They also are sensitive to assumptions about the rate of immigration and, in the case of States and subnational regions, to patterns of migration within the United States. The Census Bureau's middle-series projections assume that net annual immigration (including illegal immigrants) will be 500,000. If it instead were 800,000, then the total U.S. population in 2010 is projected to be 2.8 percent (8 million) greater than in the middle series (291 versus 283 million). Legal immigration under the Immigration Act of 1990 (P.L. 101-649) probably will fall between these two assumed levels but closer to the upper one, and further increases in legal immigration could be authorized in the future.

Increased immigration, according to Williams, would have the greatest impact on a few States where immigrants tend to settle. Almost 80 percent of the more than one million legal immigrants approved in FY1989 intended to live in just six States: California (42 percent), New York (12 percent), Texas (10 percent), Illinois (6 percent), Florida (4 percent) and New Jersey (4 percent.) This pattern of immigration has been quite consistent over the years.

The Labor Force, Wages and Productivity

Implications of demographic change for the American labor force, wages and economic growth are examined in Section III of this volume by Linda Levine, specialist in labor economics in CRS' Economics Division. The labor force grew by more than 24 million in the 1970s as the baby boomers' entry expanded it by an average of 2.6 percent per year. In the 1980s, however, the smaller baby-bust generation followed the boomers into the job market. From 1980 to 1988 the work force grew by only 15 million, or 1.6 percent annually. The number of young workers, aged 16 to 24, fell by nearly 3 million and is expected to be smaller yet in the year 2000.

Labor-force growth from 1988 to 2000 is projected by the Bureau of Labor Statistics (BLS) to slow further to an average of only 1.2 percent annually. Because unemployment in 1988 was close to the minimum level consistent with stable inflation, employment may be able to grow very little if any faster than the labor force over this period.

The youngest baby boomers will enter their thirties in the mid-1990s, while the oldest of them will be in their forties. Levine

points out that the number of workers classified as middle-aged (35 to 54 years old) is projected by the BLS to swell by 21 million (more than 40 percent) between 1988 and 2000. By 2000, nearly half of all workers will be in this age category. Meanwhile the number of workers 25 to 34 years old is projected to drop by 11 percent. In light of rising women's labor-force participation, most of this decline is expected to be in numbers of men.

Legislation passed at the end of the 101st Congress authorized an expansion of legal immigration by as much as 200,000 per year beyond immigration levels assumed in the BLS forecast. If half of these additional immigrants enter the labor force, its growth will be raised by less than one-tenth of a percentage point per year from a projected rate of 1.2 percent to less than 1.3 percent. The impact would be greater in the main immigration gateway States such as California, Florida, New York and Hawaii but correspondingly smaller in other States, particularly in the Midwest. Hence this rise in immigration will do very little to offset the slowdown of indigenous population growth.

A slowly growing labor force implies that unemployment will rise more slowly in recessions and come down faster in periods of growth, according to Levine. It seems almost certain to mean tighter labor markets in the more rapidly growing industries, occupations and geographical areas. Tendencies toward tighter labor markets would make wages more buoyant as employers compete to recruit and retain workers. A question of central importance is the extent to which faster wage increases are matched by increases in the growth of labor productivity or, alternatively, create inflationary pressures that would be held in check by tighter monetary policies imposed by the Federal Reserve. The answer to this question will determine whether slower labor-force growth will spur or hamper the increase in American living standards.

On one hand, scarcer labor and a tendency toward faster wage increases themselves pose incentives to adopt labor-saving innovations in management and equipment, which can boost productivity. This can take the form of faster rising capital-labor ratios ("capital deepening"). Examples include automation of manufacturing through the use of robots and of service industries through computerized self-service systems like telephone bill-paying at banks and automated telephone information systems of all kinds. The very fact of fewer new workers tends to make more capital available per worker.

The evolution toward a more mature work force with greater experience and better work habits should reinforce this impetus toward faster productivity gains. On the other hand, Linda Levine emphasizes that older workers are less flexible in adjusting to changes in the economy—less ready to retrain for new technologies, to change occupations, or to move to new places. They also are less recently educated and thus may be less familiar with the latest technologies. These characteristics hamper productivity in a rapidly changing economy by making the labor force less adaptable. The tendency, moreover, to lower hiring standards to obtain scarce entry-level personnel and hence the need to devote more resources to training and supervision also are likely to hamper productivity growth.

Slower labor-force growth, unless *fully* offset by faster growth of labor productivity, means slower growth of total GNP. Such a slowdown is expected by most observers. However, it would not necessarily mean slower growth of real hourly earnings or of economic living standards. Real earnings are likely to grow faster with any substantial acceleration in productivity growth, even if the change offsets only part of the slowdown in the growth of employment and total GNP hence grows more slowly.

Levine emphasizes that there are ways in which employers can attract additional workers and use them more effectively to ease tight labor markets. For various reasons the labor force of 2000 will have more women, more minority workers and many more middle-aged workers than today's. Because these diverse population groups often are underemployed relative to their full potential, there is considerable scope for increasing their productivity.

More women than men are projected to enter the labor force during the 1990s, while more men than women are projected to leave it. Although men will remain a slight majority of the work force in 2000, about 60 percent of the net additions during the decade are expected to be female. This fact, together with the likelihood of tighter labor markets, says Levine, poses a need for employers and government to adopt policies that facilitate attainment of the full productive potential of female workers. These would include policies to end sex stereotyping and other discrimination in the work place, to improve child-care and elder-care benefits, and to provide more flexible work hours, among other possibilities.

Not only has the number of young workers declined rapidly, but the qualifications of young workers, whether high-school or college graduates or dropouts, are considered by many to have slipped in the last generation or at least to be falling behind the rising demands of technology in the work place. Labor scarcity is likely to be concentrated in skilled occupations; there is no shortage of unskilled people. This poses urgent needs both for better education while in school and for more post-school job training. Employers increasingly seek to expand the availability and lower the cost of labor by moving labor-intensive functions to labor-surplus countries abroad, further eroding job opportunities for the less skilled strata of the American work force. This intensifies the need to develop advanced qualifications among American workers.

The fraction of the work force composed of black and Hispanic workers is projected to rise from 18 percent in 1988 to nearly 22 percent in 2000 because of faster population growth among these minorities. Due in part to immigration, Hispanic workers may constitute more than *one-quarter* of the net additions to the work force. But minority workers on average have less education and job experience than others and, especially among immigrants, often lack basic English language skills. Employers competing for personnel may find it necessary, according to Levine, to provide extra training, counseling and other support to such workers to make them more productive and to integrate them into their organizations.

Levine points out also that a tighter labor market is likely to motivate employers to seek workers among groups that many of them previously had not viewed as likely sources of recruits, including

retirees and displaced older workers, handicapped and partially disabled persons, individuals on welfare, persons in drug and alcohol rehabilitation programs and ex-convicts. Hence, the demographic squeeze is likely to provide new opportunities for such people, provided they can obtain the needed skills. This development also will require more training and special counseling by employers than in the past.

Added to problems of obtaining new workers with adequate qualifications, Levine contends, will be difficulty in meeting the pay and status ambitions of swelling ranks of middle-aged employees. With numbers of young workers dropping and those of middle-aged people climbing, the population "pyramid" is becoming inverted with the largest cohorts toward the top. It no longer matches the hierarchical shape of many organizations. Baby boomers will encounter intensifying congestion as they attempt to move up narrowing ladders of promotion opportunity.

The large supply of mature workers may hold down their pay increases and cause compression of wage structures, as wages of scarce entry-level workers are bid up toward those of their older colleagues. The effects of such pay compression on morale, productivity and labor-force participation of middle-aged workers may be far-reaching. Career frustration may lead to more experimentation, self-employment and early retirement. A rise in the average size of inheritances, as baby boomers fall heir to the wealth created over the past 50 years, may make it feasible for more people than in earlier generations to exercise these options. [1]

Implications for Manufacturing

The manufacturing sector has employed a declining share of the U.S. labor force since about 1950. It also has accounted for a shrinking share of the value of GNP. Newly revised data show, however, that manufacturing's share of constant-dollar ("real") GNP—at 23 percent—was the same in 1988 as in 1966 and slightly higher than in 1956 (22 percent). This contrast reflects the facts that productivity growth in manufacturing has been greater than in other parts of the economy, and that prices of goods have risen less rapidly than those of services. In fact, the growth of durable-goods manufacturing has considerably exceeded the growth of GNP over the last 15 years and is gradually increasing its share of national output when measured at constant prices.

Meanwhile, however, old-line basic industries, including steel, nonferrous metals and motor vehicles, have been squeezed for many years between slowly growing or shrinking markets on one hand and intensifying world competition on the other. They also were hit hard by the energy price increases of the 1970s. All trade-affected industries—both exporters and import competitors—were severely handicapped by the dollar's soaring exchange rate in the mid-1980s, which priced U.S. industries out of markets at home and abroad. These influences have now been reversed. Over the long term other manufacturing industries, including machinery, aero-

[1] Alan Farnham, The Windfall Awaiting the New Inheritors, *Fortune*, v. 121 (May 7, 1990), p. 72 f.

space, instruments, chemicals and plastics have grown fast enough to more than offset the retrenchment in declining sectors.

Implications of demographic trends and other foreseeable developments for U.S. manufacturing are examined in Section IV by William Cox, senior specialist in economic policy and coordinator of this volume. A hypothesis of this project was that declines in construction in the 1990s stemming from slower growth of labor force, GNP and the number of households, plus a related slowdown in growth in consumers' demand for durable goods, would further depress U.S. demand for many manufactured products and lead to renewed shrinkage of primary metals and some metal-fabricating industries. In light of the retrenchment already seen in these industries, this prospect raises questions about the success of their quest to regain viability in the face of intensifying world competition.

The careful analyses done for this volume provides a detailed picture of what demographic changes together with other important developments seem likely to imply. The discussion in Section IV of the report concentrates heavily on the outlook for durable-goods industries, which are the heart of the nation's defense-production base. It also discusses nondurable-goods producers and attempts to draw a comprehensive picture of the outlook for manufacturing into focus.

Careful analysis shows, for instance, that, despite slower projected growth in the number of households, the mismatch between the specifics of foreseeable demands for housing and the existing housing stock may sustain new residential construction activity close to the level of the 1980s. Although the number of new housing units will be smaller than in the past, the need will be for new dwellings that are larger and fancier on average, as the baby-boom generation moves into the peak earning years of middle age. As noted above, this continuing growth could be less if the baby boomers, because of their large numbers, fail on average to obtain the proportionate income gains in middle age that previous generations have enjoyed.

Regarding nonresidential construction, the analysis also notes that office and commercial building is expected to plummet in the 1990s, because of overbuilding in the 1980s, and then to grow more slowly in line with slower labor-force and economic growth. This decline is expected to be offset at least in part, however, by faster expansion of capital-intensive electric power generating and distribution capacity after a 10-year slowdown and by a revival of construction for manufacturing and agriculture as the Nation's trade balance continues to improve. Backlogged needs for improvement, maintenance and replacement of public infrastructure—especially roads and waste-water handling and treatment systems—also could help to sustain demand for industrial products, but only if funding for current or increased levels of investment in such facilities is forthcoming. These sources of strength in construction, however, are partly in the nature of catch-up demands. After they are satisfied, the need for construction can be expected to yield to the underlying demographic slowdown, unless long-term population trends change.

The outlook for construction as a whole, therefore, is for a weak recovery from the recession of 1990–91 but no persistent decline at

least until after the turn of the century. Growth in demand for building materials and built-in facilities purchased from manufacturing industries is projected to slow to less than 1 percent annually in the 1990s. A shift in nonresidential building from commercial toward industrial construction and infrastructure changes its composition to include more heavy steel and nonferrous metal components, such as pipeline, tanks and transmission lines.

Fewer household formations and less housing construction would mean slower growth in sales of household durable equipment, however, including heating and cooling equipment, kitchen and washing machinery, furniture and also motor vehicles. Less office and commercial construction has similar implications. While demographic factors are likely to depress these demands, concurrent growth in real per-capita income would work, albeit gradually, in offsetting direction. The importance of demand to replace worn-out parts of the existing stock is much more important for these products than for the very long-lived structures themselves, helping to sustain demand for current production.

In the case of motor vehicles, the Bureau of Labor Statistics (BLS) projected growth in sales of vehicles and parts, excluding inflation, of 1.8 percent per year from 1988 to 2000, down by more than half from a rate of 4.1 percent annually from 1976 to 1988. [2] This represents a radical slowdown in growth. An unknown part of this reduced growth will be captured by imports, although a declining exchange rate and more U.S. production of foreign models could limit this share (see below).

The BLS projected growth in spending on other durable consumer goods in the final 12 years of the century at 2.6 percent, exactly half of the earlier period's rate of 5.2 percent. Much of this growth will take the form of rising demand for consumer electronic goods with their rapid innovation and generally declining prices. The baby boomers have been avid buyers of such electronic products. The income elasticity of demand for these goods is high. Because many consumer electronic products are imported, however, the U.S. trade balance will not benefit as much as one might expect from the slowdown in purchases of consumer durables. Growth in demand for American-made consumer durable goods would be correspondingly slower still. [3]

The BLS also projected markedly slower growth of business investment in durable equipment: 3.2 percent annually from 1988 to 2000 versus 5.7 percent in the preceding 12 years. [4] Much of the rapid growth of the earlier period was traceable to investment in computer equipment in offices and plants, which may moderate.

Another potential development with negative implications for manufacturing industries is the long-term prospect of substantial cutbacks in procurement for the U.S. armed forces made possible by the decline of the military threat from the Soviet Union. Guidance to the armed services from the Chairman of the Joint Chiefs of Staff is to plan for a 25-percent reduction in the real purchasing

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[2] Norman C. Saunders, The aggregate structure of the economy, *Monthly Labor Review*, November 1989, p. 18.
[3] Ibid., p. 18–19.
[4] Ibid., p. 20.

power of the military budget over five years. While the composition of such a cutback has not been made clear, it presumably would be concentrated on manpower and equipment with smaller cuts in research and development of new high-technology systems. The extent to which this prospective cut will be carried out, restrained or deepened remains to be seen.

More than three-quarters of the durable goods purchases by all levels of government are made by the Federal Government, and nearly all of these are for the military. Such procurements for the armed forces grew by 8.4 percent per year, excluding inflation, from 1976 through 1988. In dollar terms they grew from $30.6 billion to $83.8 billion. State and local purchases of durables grew at 5.3 percent to $24.5 billion in 1988.

Purchases for the military in 1988 came to less than 15 percent of the total output of U.S. durable-goods industries. A cut of one-quarter would be less than 4 percent of total output. Such cuts would take effect over several years.

Military production plays a critical role in the fortunes of only a few narrow sectors such as shipbuilding, ordnance, aircraft and missiles, where it has accounted for 50 to 75 percent of gross output even in peacetime. Defense orders accounted for only 5 to 10 percent of output in broader sectors such as electrical equipment, instruments, primary metals, petroleum refining and mining.

Hence, cutbacks in procurement will impact heavily on certain firms and communities but will have small effects on manufacturing at large. With several years to adjust, some firms will be able to convert to civilian markets. Some military production, however, advances the frontiers of science and technology and has significance for industrial development that exceeds its size. Threats to the viability of certain firms specialized in critical military technologies may require special treatment to preserve needed technologies.

A prospective source of strength in demand for U.S. manufactured goods that could offset elements of weakness described above could be in markets for exports and import-competing products. Exports of durable goods in 1988 were more than twice the size of military procurements. The dollar's exchange rate already has fallen from its extraordinary heights of the mid-1980s to levels at which most American producers say that they can compete effectively again. In real terms the U.S. trade deficit had declined by 1990 by nearly three-quarters from its record 1986 level (cf. "net exports" in constant 1982 dollars in the National Income and Product Accounts). This is what counts in the fortunes of American producers.

In current dollars, however, including the effects of substantial price increases for imports (stemming partly from exchange-rate changes), the deficit remained close to $100 billion in 1990. This deficit plus the steady decline in the international balance of investment income, as our net international investment position turns negative, creates pressure for further slippage in the dollar's exchange rate in the future. The trade balance also could improve due to evident changes in the balance of savings and investment both in the United States and in Europe, Japan, the Soviet Union and the Middle East.

Manufactured products make up about 65 percent of the value of U.S. exports of goods and services. About 30 percent of total exports consist of industrial and commercial machinery and transportation equipment, of which aircraft, computers, communications gear, medical equipment, and construction and oil-drilling equipment are mainstays. Some 20 percent consist of industrial supplies and materials, including chemicals, coal and semi-processed farm products. Other manufactured exports are mainly consumer goods. The same logic suggests that import substitutes also should recapture larger shares of U.S. domestic markets. Manufactured products also constitute over 70 percent of U.S. imports. Capital goods and motor vehicles make up over 30 percent of total imports. Industrial supplies and materials, excluding petroleum, comprise about 15 percent. Consumer goods other than food and automobiles are another 10 to 15 percent.

This element of demand growth, however, also is likely to be transitory. Although most analysts believe that, after nine years of mega-deficits in the current account, the U.S. trade balance will have to improve, when a new, higher trade equilibrium is reached, this shift will cease to provide a special stimulus to growth of industrial output.

In summary, domestic demand for manufactured goods is projected to slow fairly dramatically and to equal the growth of GNP for the period, 1988 to 2000. Much slower growth in demand for consumer durable goods—especially motor vehicles and household goods—will be an element of weakness. Firms specializing in military hardware may undergo some decline, although many are also leading civilian producers and exporters. This implies further hard times ahead for producers of steel and motor vehicles.

The restraining forces of demographic change are likely to be offset in part in the 1990s by certain sources of at least transitory strength in demand for manufactures. Renewed expansion of the capital-intensive electric-power industry is foreseen. Backlogged needs for improvement, maintenance and replacement of public infrastructure—especially roads and waste-water handling and treatment systems—also could help to sustain demand for industrial products, but only if funding for current or increased levels of investment in such facilities is forthcoming.

Sectors with important stakes in the balance of trade—both exporting and import-competing sectors—should encounter stronger markets. On the assumption that the trade deficit in durable goods is eliminated during the 1990s, manufacturing would continue to grow somewhat faster than the rest of the economy and would continue gradually to increase its share of GNP in constant-dollar terms. This seems a plausible assumption for the 1990s.

But these positive factors are temporary and/or limited in their potential magnitude. Demography's downward pressure on demand for basic manufactures could become heavily dominant after these positive trends have run their courses. The interim should be seen as a respite allowing time for further development and expansion of industries based on new technologies that can provide jobs, income and exports as international competition in older technologies continues to intensify in the 21st century.

Homebuilding and Housing Markets

The market for housing and new home construction is examined in Section V by Barbara L. Miles, specialist in housing in CRS' Economics Division. Obviously the slow growth of adult population in the 1990s, particularly the plummeting number of young adults under 35 years old, implies that fewer new households will be formed than in the 1980s and 1970s. The Census Bureau's middle-level projection foresees compound annual growth in the number of households of 1.3 percent in this decade's first half and 1.1 percent in the second half, compared with 1.5 percent in the 1980s and 2.4 percent in the 1970s. This implies a further slowdown in the need for new housing construction. Actual rates of household formation will be affected, of course, by economic conditions that accelerate or suppress real income growth and/or relative costs of housing, even if only on a transitory or cyclical basis.

Slower growth in the total number of households, if uniformly distributed among ages and household types, could be accommodated through a reduction in new construction. Construction and building-materials firms and their workers would suffer from declining demand, but the market for existing housing could remain healthy with smaller additions to the stock to match the smaller increases in the number of households. Because the change is by no means uniform across housing types, however, life will not be so simply.

Complicating the influence of declining rates of household formation, according to Miles, are several factors stemming from the aging of the population that will tend to increase the amount and quality of housing per person. The number of householders, 35 to 54 years old, is projected to soar by about 3.3 percent per year, or 39 percent in the 1990s. Those within this category who are 45 to 54 are projected to increase even faster. Such people are moving into their peak earning years and are much more likely to own their homes and to have larger, better appointed homes than younger people. At the same time the number of persons under 35 years of age, especially those in the first-time-homebuying ages of 25 to 34, is dropping. The number of householders between 25 and 34 is projected to decline absolutely by more than 8 percent.

Another trend that may increase the amount of housing demanded per person is the declining role of traditional families and the rising share of single-person households. Traditional families headed by married couples are projected to constitute less than one-third of the small net increase in the number of households in the 1990s. This would reduce their overall share from about 56 to 53 percent. Other types of families, including single-parent families, are projected to make up less than one-fifth of the net increase and to remain about the same share of the total.

Single-person households, on the other hand, are expected to account for nearly half of the net increase in households in the 1990s and to rise to about 30 percent of the total by 2000. This is due in substantial part to a marked increase in the propensity of middle-aged people to live alone, whether separated, divorced, widowed, or never married. Although young single people often occupy lower-quality rental apartments, middle-aged single people typically have

higher incomes and can afford higher-quality flats or even single-family houses and often own their dwellings.

The aging of the population, therefore, augurs fairly healthy markets for single-family housing and for high-quality apartments, because additions to the stock of these will be needed in many locations. It augurs poorly, however, for lower-quality housing, especially rental apartments, which are occupied mainly by young people and, in general, by people with low incomes. Already existing numbers of such units may be more than are needed in many places in light of the declining number of young people with low incomes.

The rising median age of the population also means considerably less mobility, less need for vacant dwellings that results from mobility, and less need for new construction in areas receiving migrants. The expected increase in homeownership over renting also should reduce mobility.

After weighing these influences, Barbara Miles projects that demographic changes and other factors imply on net that the number of new housing units constructed in the 1990s will be less than in the 1980s. She projects 1.3 to 1.5 million new units per year, including mobile-home shipments, compared to about 1.75 million in the 1980s and nearly 2 million in the 1970s. But new units constructed in the 1990s probably will be bigger and fancier on average. Because middle-aged people, especially married couples, have a predilection for high-quality apartments and single-family homes, new construction probably will contain rising shares of these. Thus the total value of construction will not decline as much as the number of new units and may not decline at all.

Miles evaluates the argument that slower household formation, in addition to reducing housing construction, may cause house prices to "collapse" (or to lag other prices) over the next generation. She finds the argument exaggerated, contending that prominent proponents of this hypothesis—Gregory Mankiw and David Weil of Harvard University—misinterpret their data and infer unwarranted conclusions from them.

Using census cross-section data from 1970 and 1980, Mankiw and Weil related the ages of individuals to the value of housing they occupy. This analysis showed that the added investment peaks for people in their early thirties and that older people are associated with less housing investment. They take this to indicate a life-cycle pattern in which older adults on average invest less in housing than young ones. Barbara Miles argues that this pattern does not reveal a pattern that individuals follow as they go through life but instead reflects the fact that earlier generations had lower expected lifetime incomes than today's young people and hence consume less housing.

In contrast to the implications of Mankiw and Weil, Miles projects that many members of the baby-boom generation, who continue to dominate the demand for new housing in the 1990s, will move up to higher-quality housing as they age, as have previous generations before them. This would help to sustain the demand for houses. She points out also that the value of favorably located land presumably will continue to increase if metropolitan areas and urban congestion grow, even if they grow more slowly.

Miles points out that there are some 2.7 million baby-boom households that do not yet own homes but would be expected to, given pre-existing homeownership rates in their age categories. These households represent a reservoir of potential demand yet to be satisfied.

Miles cautions against exaggerating the argument that weakness in the market for "starter houses" will prevent the aging baby boomers from moving up to better housing. She points out that yesteryear's starter homes tend to become today's well-located neighborhoods, as jobs, infrastructure and amenities grow up around them.

Turning to the rental sector, vacancies in rental housing are high today and may remain so, according to Miles, because of the absolute drop in numbers of young people, who rely heavily on rental housing. The extent of this glut also will depend on the extent to which lower-income baby boomers, who now rent, reach levels of income and wealth, however modest, that permit them to purchase houses or, on the contrary, remain locked into renting by their low incomes.

Section III of this volume (on labor markets) points out, however, that the baby-boom generation will encounter intensified competition for advancement in income and status as promotion ladders narrow toward the top and the population age "pyramid" becomes more and more top-heavy because its younger age strata are smaller than its older ones. If the baby-boom generation, unlike its predecessors, falters in its quest for higher incomes in middle age, this will slow its attempts to upgrade its housing. Any relative decline in prices of lower-quality dwellings relative to fancier ones would reinforce this slowdown.

Miles concludes that house prices overall can be expected to increase slowly and probably to rise at rates close to or slightly below that of inflation. Prices of upscale housing will rise faster or fall by less than those of lower-quality housing. An implication of this is that the landlord-investor will be hit harder by sagging prices than the middle-class homeowner. Miles points out that a surplus of rental units presents an opportunity that has not existed for many years to subsidize the housing budgets of low-income renter households (and homeless people) without creating a scarcity of space and driving up rents for all occupants of such dwellings.

Finally, the future strength of housing and other asset prices depends heavily on the future of interest rates. If nominal and real rates remain high, as during the 1980s, buyers' monthly payments will remain inflated by borrowing costs, and the real cost of housing, including financing, will remain high. If inflation remains low or is reduced further over the long run, and interest rates subside over time, then financing will cost less, and real-estate prices will tend to rise accordingly. If inflation is reduced to low levels, both nominal and real rates of interest should decline.

Private Nonresidential Construction

The outlook for nonresidential construction is assessed in Section VI by William Cox. This category of building accounts for about one-third of total construction in the United States. It includes

office and commercial building, industrial construction, utilities and private institutional buildings.

After excluding inflation, the only long-term increase in the value of construction among these categories over the past 25 years has been in office and commercial construction. Building by private utilities was nearly its equal by the mid-1970s but fell into a prolonged slump in the 1980s while office and commercial building soared. Other industrial building also languished in the 1980s and remains below its levels of 25 years ago. Total private nonresidential construction in 1989 was barely higher in real terms than 16 years earlier in 1973.

Office and commercial building, including hotels and motels, barely paused for the recessions of 1980 to 1982 and soared by 41 percent from its dip in 1983 to its peak of 1985. It then retraced about one-quarter of this increase due to a downturn in office building and remained at that high level in the late 1980s. The boom of 1983–85 was set off by a recovering economy and a steep decline in interest rates after several years of very tight money. Generous depreciation allowances enacted with the tax reduction of 1981 also gave real-estate investors a very strong stimulus, and deregulation of thrift institutions encouraged vigorous competition among lenders to make loans on nonresidential property. The decline in office construction since 1986 is a consequence of overbuilding and resulting high vacancy rates in many parts of the country, plus the collapse of the energy boom in the Southwest and limitations on real-estate tax shelters in the Tax Reform Act of 1986.

The Nation nearly doubled its supply of office space in 10 years. Other commercial building also continued apace. Overbuilding was so pervasive that vacancy rates in office and commercial buildings soared from an average of 4 percent in 1981 to more than 16 percent in 1986 and remained in 1990 at that high level. The ironic outcome of excessive incentives to finance and build commercial buildings is that even projects that were sound at their inceptions were made unprofitable by the general glut.

Industrial construction is a different story. After reaching an all-time peak in 1979, it declined sharply in the aftermath of the twin recessions of the early 1980s. Instead of recovering during the long prosperity of the later 1980s, industrial construction slid steeply further between 1985 and 1988 to a level only modestly above that of 24 years earlier.

Construction by the utilities, about half of total industrial construction, declined due in large part to conservation by electric power users. Public opposition also hampered construction of nuclear power plants. Construction of manufacturing plants never recovered from its recession of 1983, partly because the swelling trade deficit depressed manufacturing production, and also because of a long-term decline in production capacity of certain basic industries such as steel, nonferrous metals, motor vehicles, and other metal fabrication. It also reflected relatively rapid productivity growth in manufacturing industries, which reduced the space needed for any rate of output. Slower productivity gains in service industries, which are housed in office and commercial structures, help to account for greater growth in their need for space.

In looking to the future, not only does office and commercial construction face a prolonged depression while extremely high vacancy rates come down, but it will emerge from this crisis into an economy no longer capable of growing on a sustained basis as fast as in the past. Employment growth will be markedly slower for demographic reasons, and production growth also is projected to be less. Because new building is principally for capacity expansion, office and commercial construction may never regain the levels reached in the 1980s. Rising construction by manufacturers and public utilities, however, is expected to take up much of the slack in the 1990s. Ultimately, perhaps after 2000, the demographic slowdown is likely to affect all types of construction.

The Department of Labor, using an economic model, projected that building of all private nonresidential structures except for the utilities will rise at an annual rate of 2.3 percent between 1988 and 2000, down from 3.5 percent in the previous 12 years. However construction of electric-power facilities is projected to reverse its recent decline and regain its earlier record levels by the year 2000. The absolute decline in construction by the utilities in the earlier period dragged down the growth of overall private business construction sharply. Its gradual recovery (estimated at 1½ percent per year) would reduce it by less, according to the Labor Department. The net result would be a continuation of 2 percent growth for all private nonresidential construction.

These Labor Department projections may be too high, however. They are based on an assumption that vacancy rates in office and other commercial buildings would begin to decline in 1989 and that excess capacity would be eliminated by 1993. But this improvement was behind schedule even before the onset of the 1990–91 recession. Many other observers are more pessimistic. Even if the recession ended in mid-1991, office and commercial construction would have to drop by half to bring the nationwide vacancy rate below 10 percent in three years, according to an economist for a major bank. Other commentators expect it to take most of the 1990s to digest the excess commercial space built during the 1980s. Such a depression in commercial real estate could be very hard on building materials suppliers and real-estate brokers, managers and lenders, not to mention the construction contractors and tradesmen, although some of these presumably could transfer their talents to serve the rising demand for industrial building.

Congress may entertain proposals to restore tax preferences for investors in commercial real estate as a means of reviving property prices, depressed bank portfolios and building activity. The new deficit reduction law, of course, requires sponsors of such proposals to combine them with offsetting tax increases and/or spending cuts. In considering such proposals, one should bear in mind that the Tax Reform Act of 1986 eliminated many tax preferences and their revenue losses in order to permit reduced overall tax rates and to curb the tax-induced bias among types of investments. Real-estate investment, almost always financed by heavy borrowing, still is favored by the tax deductibility of the interest payments. Before again augmenting this preference, one should consider the excess office capacity created in the 1980s and ask whether spurring this type of investment is in the national interest. Both labor and sav-

ings may be scarce in the future and must be used for the highest-priority purposes, which most economists think are best indicated by the market itself and not by the tax code.

Transportation Infrastructure

The implications of demographic change for surface and air transportation and the need for transportation infrastructure are examined in Section VII by Jeff Hornbeck, economic analyst in CRS' Economics Division.

Road transportation infrastructure—highways and bridges—is the largest component of the Nation's infrastructure investment. The need for expansion of such facilities beyond the basic road network is determined by many economic and demographic variables. Among the most important is labor-force growth, which has dramatically intensified peak-period traffic in metropolitan areas. Thus labor-force growth, Hornbeck points out, is more relevant than total population change to explaining the need to expand roads and bridges.

The work force has grown considerably faster than the total population since about 1965, as the baby-boom generation entered the work place, and increasing fractions of the adult female population chose to work outside the home. Commuter traffic has intensified also with the rising number of motor vehicles available per worker. In fact, growth in vehicle ownership and single-occupant usage has greatly outpaced growth in population, work force, and the number of commuters, further aggravating congestion.

In addition, more than 85 percent of the population growth since 1950 has occurred in suburbia, with little growth or outright declines in population recorded in many central cities and rural areas. Many of the new jobs also are located in the suburbs. Suburb-to-suburb commuting accounted for more than half of the rise in commuter traffic from 1960 to 1980. Only about one-quarter of the growth was in trips to and from downtown areas. This change in commuting patterns was not easily accommodated by mass-transit systems, especially rail systems, so commuting has shifted increasingly to the roads. Hence, says Hornbeck, road capacity between suburbs and downtown and, especially, linking suburbs to each other is heavily utilized during rush hour in many medium-size and large metropolitan areas.

The projected slowdown in the growth of employment in the 1990s should curtail the *rate of increase* in traffic and congestion in most areas. Furthermore, 85 percent of the adult population are now licensed to drive, including 95 percent of those under 35 years old, and the number of people reaching driving age is down. Thus the number of potential new drivers as a source of traffic growth has shrunk to a fraction of its former size.

Data indicate in addition, according to Hornbeck, that road travel per motorist increases with age until about 45 but declines after that by more than half before the age of 65. Thus the rapid aging of the population also should slow the growth of travel, especially after the year 2000, although this part of the decline may not come mainly from the peak rush-hour load for which most road systems must be designed.

The Federal Highway Administration (FHWA), using an elaborate simulation model, projects that the annual growth in road travel from 1988 to 2005 will average between 2 and 3 percent, down from 3.5 percent over the previous 20 years. FHWA's point estimate is 2.3 percent. This would be a decline in the *growth* of traffic by about one-third, which ultimately should allow some reduction in the rate at which road capacity is expanded.

Hornbeck argues, however, that the need to add capacity to the road network even to serve today's traffic and, more important, the growing needs to rehabilitate and replace roads and bridges, will sustain the demand for infrastructure investment in the 1990s. FHWA, recognizing rehabilitation needs, calls maintaining existing structures "a formidable challenge."

In one FHWA scenario, described as a "constrained full needs strategy," backlogged and accruing deficiencies in the highways would be repaired to meet at least "minimum standards." Only limited capacity increases would be made. The spending required would range between $30 billion and $35 billion per year for roads and perhaps another $5 billion for bridges. This would not include spending for local roads and streets. All such estimates depend heavily, of course, on the underlying definition of adequacy. In 1988, by comparison, outlays for roads and bridges by all levels of government were $31.6 billion, suggesting that significant increases in infrastructure spending will be needed to meet the surface transportation needs of the coming decade. Congress is working in autumn 1991 to complete reauthorization of Federal highway funding.

There are, as Hornbeck points out, alternatives to road construction for reducing congestion. These include improved means of traffic management such as electronic systems to limit traffic flow into congested areas and to warn motorists of congestion and guide them around it. While these techniques are untested in large-scale use, increasing application of electronic devices in all areas of life suggest that they may spread in the future. Greater use of carpooling, buses and rapid-transit systems by commuters also could conserve on road capacity, but stagnant or declining ridership and rising subsidy requirements of most transit systems make them small players in the overall transportation picture except in a few large metropolitan areas.

Airport and air-traffic control facilities also face challenges from growth. This challenge is concentrated among the busiest 100 airports, which handle 95 percent of all airline passengers, according to Hornbeck. Indeed, the busiest 25 airports carry two-thirds of the traffic.

Total enplanements by commercial airline passengers are projected by the Federal Aviation Administration (FAA) to increase at a compound annual rate of 3.9 percent from 1988 to 2001. Total takeoffs and landings directed by 399 FAA-run control towers, however, are projected to increase by only 2.1 percent, because general aviation—the majority of aircraft operations—is expected to grow much more slowly than commercial operations.

The growth both of passengers and aircraft operations, nonetheless, will run up against capacity constraints at many airports unless traffic is routed around them or their facilities are expand-

ed. Operations at 22 airports in 1990 were limited by capacity. Without major runway expansions, the FAA projects that this number would nearly double within 10 years, affecting a sizeable majority of air travelers. Because the air-transportation system is an intricate network, bottlenecks in a few places would disrupt aircraft use and passenger connections throughout the country.

Eight of the ten most heavily used airports in terms of total landings and takeoffs are in the South and West. These rankings are heavily influenced by the importance of private aircraft at some of these locations. Commercial service is concentrated also at several places outside these regions, such as New York and Chicago, and is growing very rapidly at other new hubs such as Raleigh, Charlotte, Memphis, Minneapolis and other cities. If demographic projections are correct, the growth of population and hence probably of commercial air traffic in the next two decades also will be concentrated in the Southeast and the Southwest (including California).

Fifty of the largest 100 airports have plans to expand facilities. In 1986 the FAA projected that to make all needed improvements in commercial, reliever, and general aviation airports would require $24.3 billion in Federal funding over 10 years. The Federal contribution earmarked in the FAA's FY91 budget is $1.8 billion. Runway and ancillary expansions accounted in FY88 for three-quarters of Federal funding for airport improvement at the top 100 airports.

Federal grants for airports, however, contribute less than 20 percent of total airport spending. Far larger resources for capital projects are drawn from State, regional, and local government and from private sources. State and local own-source outlays for airport capital improvements as of 1988 were approaching $18 billion. The 101st Congress approved an increase in taxes on air transportation that for at least 2 years will go into the general fund to reduce overall budget deficits. It also authorized local airport authorities to request permission from the Department of Transportation to levy passenger facility charges (departure taxes) to finance airport improvements.

As in the case of highways, the solutions to airport congestion include options other than simply constructing more runways and terminals. High costs, local opposition and long lead times make expansion impractical in some places. Easing air-traffic congestion also involves improved traffic management. This possibility relies mainly on completion of the National Airspace System Plan, a multibillion-dollar modernization of the air-traffic-control facilities that will enter service in the 1990s.

Water Supply and Wastewater Treatment

Requirements for water supply and wastewater treatment infrastructure are assessed in Section VIII of this volume by Claudia Copeland, CRS specialist in environmental policy in the Environment and Natural Resources Policy Division. Most of the attention is on wastewater treatment facilities, because Federal funding is heavily concentrated there. Cost estimates are cited also for upgrading of inadequate sewer systems and for water supply facili-

ties, for which the Federal role is limited mainly to environmental protection and setting water purity standards. The need to build such infrastructure is sensitive to rates of population growth and to changes in the location of population and economic activity. As with road systems, the capacity of water systems must be designed to accommodate the peak period's demand.

Since the Federal matching grant program that helps to finance waste-water treatment facilities under the Clean Water Act was expanded in 1972, Congress has appropriated $50 billion (an average of about $2.75 billion per year) for such grants. Copeland states that annual appropriations since 1980 have averaged $2.3 billion. Total Federal, State and local spending on wastewater treatment facilities reported to the Environmental Protection Agency (EPA) has averaged about $3.6 billion annually in recent years, so Federal grants have contributed nearly two-thirds.

In 1987, however, Congress changed the nature of Federal participation by earmarking $8 billion in Federal funding between 1989 and 1994 to capitalize State revolving funds for water pollution control projects. Loans obtained from these funds by local authorities will have to be repaid to the States. Federal assistance under the Clean Water Act is now scheduled to end after 1994.

Because of requirements of the Federal program, comparable estimates of future needs for wastewater treatment facilities have been made by all States. This is not true for water supply facilities. The most important pieces of information needed for planning wastewater systems, Copeland states, are population projections, per-capita wastewater flow projections, and the amounts and types of industrial discharges. Reliable population projections are essential. In fact, applications for Federal grants are required to be based on up to 20 years' projected population growth, estimated in accordance with the Census Bureau's procedures and consistent with its mid-level projection of national population. To improve the accuracy and consistency of the cost estimates, EPA also has developed guidelines and standards of documentation to be used by the States.

Information compiled by the States on projected infrastructure requirements is integrated into a report on national needs by EPA in cooperation with the States. The most recent report, completed in 1988, indicated that States need to invest $68 billion in wastewater treatment facilities to meet requirements of existing populations, plus $15 billion to accommodate developments projected to occur by the year 2008. At 1988 prices, this would mean an average of $3.4 billion annually for backlogged needs and $750 million more for new ones, for a total of $4.15 billion per year from all sources. This would be somewhat more than the $3.6 billion spent annually in recent years. While these sums are supposed to be sufficient to eliminate the widespread deficiencies of existing wastewater treatment, they do not include extensive work that will be needed in many States on sewer facilities other than treatment plants or any expenditures for water supply facilities.

Here again, as in the case of roadbuilding, increased funding appears to be needed to correct backlogged deficiencies despite the marked slowdown in population growth and the likely decline in population mobility. Wastewater treatment facilities have been

built mainly over the past generation, and many communities still are struggling to bring their systems up to the standard required by Federal law. If these funding needs are met, however, the investment would considerably upgrade the quality of wastewater treatment from today's levels so that reduced requirements might be expected after the backlog is surmounted.

The formula adopted in 1972 for distribution of Federal aid among States gave preference to States with large and growing populations. It was designed to help in meeting the wastewater treatment needs of future as well as present population. The program has been changed, however, according to Copeland, to give a slight preference to small States and to provide support mainly for *current* needs but not for anticipated population growth or economic development. Future needs are expected to become the responsibility of the States and localities.

If State shares of Federal funding for wastewater treatment facilities are placed on a per-capita basis, six high-growth States receive very small amounts per person. These are Arizona, Colorado, California, Georgia, North Carolina and Texas. Other high-growth States with small shares are Florida, Utah and New Mexico. Unless other factors mitigate their needs for Federal co-funding, these States may find it difficult even to meet the needs of current populations, much less to provide for anticipated growth. Some adjustment of the formula may be in order, although it will make little difference unless the funding program is extended beyond 1994.

Claudia Copeland shows that wastewater treatment funding projected to be required by *growth* from 1988 to 2008 as a percentage of *total* wastewater treatment funding required by then (including the present backlog) ranges from 3.4 percent for growth in Vermont to 52 percent in Alaska. The median is 20 percent for California. In this ranking, 14 of the 19 States with above-average projected population growth over this period have wastewater facility needs for growth above the median. That is as expected.

However, Copeland notes that two States with above-average population growth projections have only small amounts of funding identified for waste-water growth. These States are Maryland, with only 6 percent of its estimated wastewater facility needs associated with growth, while the Census Bureau projects population growth of 19 percent for the two decades ending in 2008; and New Jersey, which has identified 11 percent of its wastewater facility needs for growth but has population growth projected at 15 percent. It is possible that planners in these two States are underestimating future growth needs.

On the other hand, two States that are projected to lose population—Kentucky and Iowa—have relatively large amounts earmarked for growth relative to current needs, 24 and 21 percent respectively. These States may be planning for growth that will not occur. It may also be, however, that their estimates of future needs stem from growth in certain parts of these States that must be provided for even if population is declining in other areas. It may also include some projects actually needed for present population that have not been documented sufficiently to be included in the current backlog under EPA's rules.

As stated above, Federal, State and local spending on wastewater treatment facilities reported to EPA has averaged about $3.6 billion annually in recent years. If this rate of construction were to continue, Copeland notes, the current $68-billion backlog could be eliminated in slightly less than 20 years, assuming that requirements to accommodate growth in the meantime were deferred. Even this degree of attainment is not likely to happen, in her judgment, because Federal grants, which now contribute two-thirds of these outlays, are scheduled to end in 1994.

In addition, the sizeable costs of eliminating sewage overflows that result when combined storm and domestic-waste sewers are overtaxed by heavy precipitation run-off—projects generally not eligible for Federal assistance—have not been included in the financing needs cited above. EPA's 1988 estimate of $16 billion to correct this problem included only well documented construction proposals. Some experts believe that the cost to control all such problems could rise to more than five times this amount ($85 billion) as cities make more complete estimates of costs to correct problems of this type. To these costs must be added the much smaller costs of complying with the Safe Drinking Water Act, which requires filtration and disinfection of water supplies and reduction of various contaminants to within permissible limits.

EPA has estimated that the costs of complying with recent and forthcoming regulations for drinking water, wastewater treatment and other environmental purposes may raise households' costs by 50 to 100 percent from present levels or by an average of 0.4 percent of household income. The burden would be heaviest in small cities, partly because they have invested the least to date.

The ability of States and municipalities to finance all of these requirements is in doubt, especially if Federal funding is terminated. To make matters worse, according to Copeland, the heavy costs of correcting combined sewer overflows and replacing dilapidated sewer systems will be concentrated in the Great Lakes Region and the northeastern States that are projected to experience little population growth or even losses over the next two decades. A slowly growing tax base would make it especially difficult to surmount this burden. On the other hand, any move to extend Federal cofunding for these purposes after 1994 will conflict with the drive to reduce the Federal budget deficit. New sources of revenue, perhaps from user fees or earmarked taxes, probably would be needed. Reform of municipalities' water and sewer usage fee systems also can make a substantial contribution to conservation in water usage, slowing growth of demand for water-supply and waste-treatment infrastructure. The Congress will debate issues arising from these projections in considering reauthorization of the Clean Water Act, which expires in 1994.

II. THE U.S. POPULATION, 1970 to 2010: SIZE, GEOGRAPHIC DISTRIBUTION, AND AGE STRUCTURE

by Jennifer D. Williams *

The U.S. population increased by 22 percent (45 million) in the past 20 years and could grow by at least another 13 percent (33 million) from 1990 to 2010. This report examines patterns of past and projected growth: the regions, divisions, [1] and States with major population gains; the areas with losses or small gains; and the role of international as well as internal migration in population change. Attention is also focused on changing age structure at the national and subnational levels: trends in the numbers and proportions of preschoolers, persons of school age, younger and older working-age adults, and the elderly. The method used to project future population size and age structure is explained, as are the limitations of population projections.

Patterns of Growth, 1970–1990

Decennial census figures for 1970, 1980, and 1990 and intercensal estimates show that, in absolute numbers as well as percentage terms, most population growth during the past two decades occurred in the South and West regions of the United States (Tables 1, 2, 3, and 6, pp. 41–43 and pp. 45–46). While U.S. population increase was roughly 10 percent in each of these periods (23 million in the 1970s and 22 million in the 1980s), the West grew at more than twice that rate (8 and not quite 10 million, respectively) and the South by 20 and 13 percent (almost 13 and 10 million). Together, these regions accounted for about nine-tenths of the country's growth in each decade. [2] Of the 10 States with greatest numerical or percentage gains from 1970 to 1990, all except New Hampshire and New York were in the South or West (Tables 4 and 5, p. 44).

Growth was not uniform, however. In the Mountain division of the West, Montana's population increase was just 2 percent (12,000), and Wyoming had a 3 percent (16,000) population decrease from 1980 to 1990, while Arizona, Colorado, Nevada, New Mexico, and Utah grew by 14 to 50 percent. Alaska, with 37 percent growth (148,000), outpaced all other States in the Pacific division in percentage terms; California and Washington, which had the largest numerical gains, increased by, respectively, 26 percent (6 million) and 18 percent (735,000). In the South, States of the South Atlantic

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[1] The U.S. Bureau of the Census divides the country into four regions and nine divisions. Figure 1 (p. 40) shows these areas, with the States they include.

[2] Computed from data in Tables 1 and 2.

division had the highest rates of population gain: Florida increased by 33 percent (3 million); Delaware, Georgia, Maryland, North Carolina, South Carolina, and Virginia grew by 12 to 19 percent. An exception to this pattern was West Virginia, where population decreased by 8 percent (157,000). States of the East South Central and West South Central divisions made gains between 0.3 and 6 percent, except for 19 percent (3 million) growth in Texas. Generally, then, population increase was concentrated in the Southeastern, Southwestern, and Pacific States. Three of them combined—California, Florida, and Texas—accounted for 54 percent of U.S. population growth (12 out of 22 million) from 1980 to 1990 and 42 percent (almost 10 out of 23 million) in the 1970s.

Offsetting rapid growth in the South and West were low to moderate regional increases elsewhere. The Midwest region grew by 4 percent (2 million) in the 1970s, but by less than half as much (1 percent, or 803,000) in the following decade. Between 1980 and 1990, Iowa and North Dakota sustained respective net population losses of −5 percent (−137,000) and −2 percent (−14,000).[3] Gains in the other Midwestern States during the 1980s ranged from less than 0.1 percent (4,000) in Illinois to 7 percent (299,000) in Minnesota. Most Midwestern growth took place in the West North Central, not the East North Central, division. The Northeast region grew by just 0.2 percent (74,000) in the 1970s, but 3 percent (2 million) during the next 10 years. New Hampshire's 20 percent (188,000) increase from 1980 to 1990 surpassed the growth rate of every other Northeastern State for the decade; however, New York, with a 3-percent gain, showed the largest numerical increase (432,000). Pennsylvania had the lowest percentage and numerical growth in the Northeast (0.2 percent, or 18,000). In the New England division, every State increased by at least 5 percent during the 1980s, while in the Middle Atlantic division, only New Jersey grew at that high a rate. Nevertheless, the two divisions did not diverge widely in absolute population increases (859,000 versus 815,000).

Migration (international as well as internal) figured importantly in population change. All 10 States with the most rapid growth in the 1970s and, even more so, from 1980 to 1988, could attribute much of it to migrants (Table 4, p. 44). In California, Florida, and Texas—the top three growth States of both decades—migration was responsible for 54, 88, and 43 percent, respectively, of population increase from 1980 to 1988. The three States that lost population during the same period—Iowa, Michigan, and West Virginia—did so because migration losses were greater than natural increase (births − deaths). No State had more deaths than births. In the 20 other States with negative net migration, natural increase exceeded migration losses, sometimes by considerable margins, so that the States continued growing.[4] Between 1980 and 1988, the South and

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[3] Ibid.

[4] U.S. Bureau of the Census. *State Population and Household Estimates, with Age, Sex, and Components of Change: 1981-88. Current Population Reports*, Series P-25, no. 1044. Washington, Govt. Print. Off., 1989. p. 13. Migration data are not yet available from the 1990 decennial census. Therefore, the discussion of migration and population change in the 1980s is based on the 1980 through 1988 information cited above.

West had respective net migration rates [5] of 6 and 8 percent (Table 6, pp. 45–46). Most of the South's migration gain occurred in the South Atlantic division, particularly Florida. Texas and Georgia received the region's second and third largest numbers of migrants. In the West, the Pacific division drew almost four times as many migrants as the Mountain division. California was the primary Western magnet, with Arizona and Washington ranking second and third.

In contrast, every Midwestern State except Missouri lost more migrants than it gained between 1980 and 1988, and the net migration rate for the region as a whole was −4 percent. Iowa, Michigan, and North Dakota had the three lowest rates (−7, −6, and −6 percent, respectively), while Michigan, Illinois, and Ohio sustained the greatest numerical losses. The Northeast's −0.6 percent rate was due to out-migration from three States: Massachusetts, New York, and Pennsylvania. The other States of this region had net migration gains or (in Connecticut) no change.

Population Projections, 1990–2010 [6]

From now through the first decade of the 21st century, the Nation is projected to have lower population growth rates than during the previous 20 years: 7 percent in the 1990s, decreasing to 5 percent between 2000 and 2010, contrasted with rates of approximately 10 percent in each of the past two decades (Tables 2 and 3, p. 43).

Likewise, the South and West regions—though they would continue as the loci of U.S. population growth—would increase at decelerating rates. In the 1990s, the South is projected to grow by 11 percent, then by 8 percent from 2000 to 2010. Gains in the West for these respective periods are projected at 14 and 10 percent. Among Southern divisions, the South Atlantic, followed by the West South Central, would show the greatest numerical and percentage increases. The Mountain and Pacific divisions of the West would have roughly comparable rates of increase, but the Pacific (with its larger numerical base) would gain more population.

The population of the Midwest region, on the other hand, is projected to decrease by 0.3 percent in the 1990s and 1 percent a decade later. All the loss would occur in the East North Central, rather than the West North Central, division. (Certain West North Central States could lose population, however.) The Northeast, while not expected to decline, would increase relatively slowly during the next two decades: by 2 and 1 percent, respectively. Percentage and (from 2000 to 2010) numerical gains would be greater in the New England than the Middle Atlantic division.

In 2010, the South would rank first in population size, the rank it had in 1970 and each intervening decade. No other region would maintain the same rank for 40 years. The West would move from

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[5] Net migration here = an area's total in-migration − total out-migration from 1980 to 1988. The net migration rate for the area = (net migration from 1980 to 1988 / the area's 1980 population) × 100.

[6] The projections discussed here presuppose below-replacement fertility and moderate immigration levels. An explanation of these assumptions and their limitations appears in the last two sections of this report.

fourth to second place, while the Midwest would slip from second to third and the Northeast from third to fourth place.

Between 1990 and 2010, California would remain the most populous State (Table 7, p. 47). By 1991, Texas would replace New York as the second largest State. Florida would remain in fourth place throughout the 20-year period. By 2010, California, Florida, and Texas would contain 27 percent of the U.S. population, up from 24 percent in 1990. Six Northeastern and Midwestern States (Illinois, Michigan, New Jersey, New York, Ohio, and Pennsylvania) would rank among the top 10 in population size in 2010, as in 1990, but their share of the country's total population would decrease from 28 to 25 percent.

Of the 10 States with greatest projected percentage increases during the 1990s and from 2000 to 2010 (Table 8, p. 47), nine are in the South or West regions, as were the top 10 growth States of the 1970s and the top nine a decade later (Table 5, p. 44). And, as occurred in the past two decades, fastest growth is projected mainly for the Southeastern, Southwestern, and Pacific States.

At the opposite extreme, the 10 States projected to have the largest percentage losses between 1990 and 2010 (Table 8) are located chiefly in the Midwest or Northeast regions. Exceptions include Montana, Wyoming, and West Virginia for the 1990s and only West Virginia a decade later.

As during the past two decades, migration would continue to be an important factor in population change at the national and subnational levels.[7] International migration is projected to contribute 30 percent of U.S. population growth in the 1990s and 35 percent from 2000 to 2010, with the remainder due to natural increase.

Immigration might also make the difference between net migration losses or gains in the Midwest and Northeast. In the 1990s, neither region is expected to attract enough immigrants to compensate for out-migration to other regions. From 2000 to 2010, this pattern might continue in the Midwest, but not in the Northeast, where gains from international migration could slightly exceed negative net internal migration.

Every Midwestern State except Missouri is projected to have negative net migration over the next 20 years, though losses would be much greater in the East North Central than the West North Central division. In the Northeast, the Middle Atlantic States of Pennsylvania and New York would have the largest net out-migration numbers, while the New England States would tend to gain migrants.

The projections show the South and West regions drawing internal as well as international migrants for the next 20 years. Generally, the South would receive greater numbers of internal migrants, while the West would attract more immigrants. In the 1990s, migration could account for 53 percent of the South's population increase (slightly over 40 percent from internal migration and not quite 13 percent from immigration) and 44 percent of growth in the West (13 percent from internal and 31 percent from

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[7] U.S. Bureau of the Census. *Projections of the Population of States, by Age, Sex, and Race: 1988 to 2010. Current Population Reports*, Series P-25, no. 1017. Washington, Govt. Print. Off., 1988. p. 26–27.

international migration). Between 2000 and 2010, 59 percent of growth in the South would be traceable to migration (45 percent internal and 14 percent international); 41 percent of the West's population increase would be from migration (7 percent internal and 34 percent international).

By 1995, for example, Florida's projected growth could depend entirely on migration, most of it internal, as deaths begin to exceed births. Texas could attribute 32 percent of its population increase during the 1990s and 24 percent a decade later to migration. Like a Western State instead of a Southern one (despite its inclusion in the U.S. Bureau of the Census' South region), Texas would attract many more immigrants than internal migrants. Of California's projected growth in the next two decades, 49 and 47 percent, respectively, would be due to migration, predominantly international.

Five of the six remaining highest-growth States in the South or West (Table 8, p. 47) would also receive substantial portions of their projected gains from migration: Arizona, 68 percent in the 1990s and 67 percent in the subsequent decade; Georgia, 62 and 60 percent, respectively; Hawaii, 69 and 75 percent; Nevada, 70 and 69 percent; and New Mexico, 48 and 36 percent.

Changing Age Structure, 1970–2010

1970–1990 [8]

The age distribution of the U.S. population (the percentage of the population in each age category) is more sensitive to changes in fertility and mortality than to changes in net immigration. Age distribution is shown in Table 10 (p. 49), with the corresponding numbers in Table 9 (p. 48) and percentage changes in the numbers, by decade, in Table 11 (p. 50). While international migration can markedly affect total population size, "net immigration is not so concentrated in a particular age range as are fertility and mortality. Its impact [on age distribution] is thus comparatively diffuse." [9] In other words, all births occur at age zero, and deaths tend to occur at advanced ages. Compared with these events, immigration takes place across a broader age spectrum.

Nevertheless, immigrants in general are younger than the total population, as data for 1989 illustrate. In that year, 65 percent of the persons granted immigrant status—but 54 percent of the U.S. population—were under age 35. Only 3 percent of immigrants—in contrast to 12 percent of the total population—were age 65 or older. Especially significant for the labor force is immigrants' overrepresentation in the younger working ages. Half of the persons granted immigrant status—but a third of the total population—were 15 through 34 years old in 1989. Another third of each group was in the older working ages (35 through 64 years). [10]

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[8] Detailed age data are not yet available from the 1990 decennial census. Therefore, information about changing age structure from 1980 to 1990 is based on population estimates through 1988 and projections for 1990. (Tables 9 through 11 show projections by age categories.)

[9] U.S. Bureau of the Census. *Projections of the Population of the United States, by Age, Sex, and Race: 1988 to 2080. Current Population Reports*, Series P-25, no. 1018. Washington, Govt. Print. Off., 1989. p. 18.

[10] U.S. Bureau of the Census, *Projections of the Population of the United States*, p. 40–41. U.S. Immigration and Naturalization Service. *Statistical Yearbook of the Immigration and Naturalization Service, 1989*. Washington, Govt. Print. Off., 1990. p. 24.

With respect to U.S. fertility, the reluctance of the "baby boom" cohorts (persons born between 1946 and 1964) to have children during the 1970s produced, in succession, lower numbers and percentage shares of persons under age 5, school-age children (5 through 17 years old), and young adults (ages 18 through 24). The population under age 5 decreased steadily until the late 1970s, dropping from 17 million (8 percent of the U.S. total) in 1971 to 16 million (7 percent of the total) in 1977. [11] Preschoolers born during the so-called "baby bust" years became the school-age population, which decreased by 4 percent nationally from 1980 to 1988; then these children moved into the young adult category, which decreased by 11 percent in the same period.

An upswing in fertility followed the baby bust. The number of persons under age 5 increased annually, approaching 19 million (back to 8 percent of the total) in 1988, the highest number since 1967. As these children reached age 5, beginning in 1984, the decline in the school-age population reversed.

The age group 25 through 44 years old was the fastest growing (with a 26 percent increase) from 1980 to 1988 because it comprised the baby boom cohorts. Persons of these ages constituted 32 percent of the total population in 1988, up from 28 percent in 1980.

In contrast, the national population aged 45 through 64 years increased by only 3 percent during the same period. This category, which made up 20 percent of the population in 1980 and 19 percent eight years later, will begin to expand in the early 1990s, when the oldest baby boom cohorts reach age 45.

The elderly population (aged 65 years and older) grew by 19 percent between 1980 and 1988, becoming 12 percent of the total. The median age of the U.S. population (the age with half the population above and half below it) increased from 30.0 to 32.3 years. [12]

At the subnational level, in contrast to the total United States, net migration has important effects on age distribution. Net in-migration, for example, in the South and West regions between 1980 and 1988, tends to make the population of an area younger. Net out-migration, as in the Midwest and Northeast, has the reverse tendency. [13] Migrants, even though they may include older as well as younger persons, are generally younger than nonmigrants, so that "fast-growing areas typically have higher fertility and lower mortality than areas with sustained out-migration." [14] Thus, from 1980 to 1988, the Midwest had the largest increase in median age of any region (2.7 years, to 32.3 years), while the Northeast retained the highest median (31.8 years in 1980 and 33.9 years in 1988). Except for Florida, all States with medians over 34.0 years were in the Northeast (Connecticut, New Jersey, and Pennsylvania). Florida, which is a magnet for the elderly (and so illustrates the observation that not all migrants are young), had the highest

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[11] U.S. Bureau of the Census. *State Population and Household Estimates to 1985, with Age and Components of Change. Current Population Reports*, Series P-25, no. 998. Washington, Govt. Print. Off., 1986. p. 30-39.

[12] U.S. Bureau of the Census, *State Population and Household Estimates, with Age, Sex, and Components of Change: 1981-88*, p. 4-5.

[13] U.S. Bureau of the Census, *State Population and Household Estimates to 1985*, p. 2.

[14] Frey, William H. *Metropolitan America: Beyond the Transition. Population Bulletin*, v. 45, no. 2. Washington, Population Reference Bureau, 1990. p. 20.

median age in 1988 (36.4 years). Utah, because of very high fertility, had the lowest median (25.7 years). [15]

Alone among regions, the Midwest experienced a decrease (0.4 percent) in the population under age 5 from 1980 to 1988. Of the seven midwestern States that lost preschoolers, Iowa sustained the largest loss (−14 percent). The Northeast had a 12 percent increase, with New Hampshire making the largest gain (29 percent) in the region. Florida registered the most rapid growth of any State in the population under age 5 (49 percent). All other States where this category grew by more than a third were in the West: Alaska, 47 percent; Nevada, 45 percent; Arizona, 40 percent; and California, 39 percent. As previously indicated, much of this growth came from migration. [16]

During the same period, the Northeast and Midwest had substantial losses of children 5 through 17 years old (−14 and −10 percent, respectively). All States in both regions experienced decreases in this category. The West had an 8 percent gain, and the South showed virtually no change. In the South, only Florida, Georgia, Oklahoma, and Texas gained school-age children, as did all Western States except Montana and Oregon. [17]

Each region and every State except Alaska, Arizona, Florida, Nevada, and New Hampshire reflected the national contraction of young adults (18 through 24 years old) between 1980 and 1988. The Midwest had the greatest regional loss (−18 percent versus −11, −9, and −7 percent, respectively, in the Northeast, West, and South). Nineteen States had losses greater than −15 percent: all 12 Midwestern States; Pennsylvania in the Northeast; Louisiana and West Virginia in the South; and Idaho, Montana, Oregon, and Wyoming in the West. [18]

All regions and States gained baby boomers (25 through 44 years old), with larger gains occurring in the West (35 percent) and South (29 percent) than in the Northeast (20 percent) and Midwest (19 percent). From 1980 to 1988, this category grew by a third or more in 11 States: eight in the West (Alaska, Arizona, California, Colorado, Nevada, New Mexico, Utah, and Washington); two in the South (Florida and Texas); and one in the Northeast (New Hampshire). [19]

While older working-age adults (45 through 64 years) decreased by 2 percent in the Midwest and Northeast during this period, they increased by 10 and 8 percent, respectively, in the West and South. Every Midwestern State except Minnesota and Missouri lost persons 45 to 64 years old, as did Connecticut, Massachusetts, New York, Pennsylvania, and Rhode Island in the Northeast. Of the 11 States where the older working-age category grew by more than 10 percent, all but New Hampshire were in the South or West. Increases exceeding a fifth occurred in four States: Alaska (46 percent), Florida (23 percent), Arizona (22 percent), and Nevada (22 percent). [20]

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[15] U.S. Bureau of the Census, *State Population and Household Estimates, with Age, Sex, and Components of Change: 1981–88*, p. 4–5.
[16] Ibid., p. 4–5, 64.
[17] Ibid.
[18] Ibid.
[19] Ibid.
[20] Ibid.

Consistent with their overall population growth (through natural increase and net in-migration), the West and South gained more elderly persons from 1980 to 1988 than did the Midwest and Northeast (28, 22, 14, and 13 percent, respectively). This category expanded in every State. Nevada and Alaska had the steepest increases (respectively, 72 and 71 percent). In 1988, however, the elderly constituted the smallest proportion of total State population in Alaska (4 percent) and the largest in Florida (18 percent). [21]

1990–2010

In the last decade of this century and the first decade thereafter, the U.S. population is expected to grow steadily older, with a projected median age of 33.0 years in 1990 and 38.9 in 2010. The preschool population would decrease by 8 percent (from 18 to 17 million) between 1990 and 2000, but, after a further decline, would return to 17 million by 2010. The school-age population would be about the same in 2010 as in 1990 (46 million), increasing to 49 million in 2000 and then decreasing. The aging of the baby boom cohorts over the next 20 years could produce a 68 percent increase in the population 45 through 64 years old (from 47 to 79 million). [22] Not until these cohorts reach age 65, after 2010, would the elderly population grow most dramatically; nevertheless, it is projected to increase by 25 percent (from 32 to 39 million) in the next two decades. [23]

The Northeast, where the median age is projected at 34.5 years in 1990 and 40.3 by 2010, would continue to be the oldest region. The West would have the lowest median age, 32.3 years in 1990 and 37.4 in 2010. In the 1990s, every region is expected to lose persons under age five. The loss would be greatest for the Midwest (−675,000, or −15 percent from this age category) and least for the West (−140,000, or −3 percent). From 2000 to 2010, the Midwest and Northeast would continue to lose population at the youngest ages, while the West and South would gain. The school-age population would increase in every region during the 1990s and decrease a decade later, but the Midwest would have by far the smallest gain, followed by the largest loss. In the 1990s, the only region with projected growth (7 percent) in the young adult category is the West, where in-migration of persons aged 18 through 24 years is expected to "compensate for the natural shifts in age structure." [24] Between 2000 and 2010, all regions should gain young adults; numerical as well as percentage growth would be greatest in the South and West and least in the Midwest. Decreases in the population 25 through 34 years old are projected for all regions during the next 20 years (except for the South and West from 2000 to 2010), and there should be fewer 35 through 44-year-olds in every region from 2000 to 2010, as the baby boom leaves these two categories

[21] Ibid.

[22] While this discussion focuses on projected percentage changes in age structure over the next 20 years, Table 11 (p. 50) presents these changes by decade: 1970 to 1980, 1980 to 1990, 1990 to 2000, and 2000 to 2010. It should be noted that percentage change for 1990 to 2010 is not mathematically equivalent to the sum of the change from 1990 to 2000 and the change from 2000 to 2010.

[23] U.S. Bureau of the Census. *Projections of the Population of States*, p. 6–8.

[24] Ibid., p. 6.

and enters the range of 45 through 64-year-olds. While the latter age group should grow in each region from 1990 to 2010, it could expand by 93 percent in the West and 80 percent in the South; the South should have the steepest numerical increase (13 million). The South would also gain the largest number of elderly persons (4 million); the second largest numerical increase (2 million) and the greatest percentage growth (43 percent) would occur in the West.

Every region would continue reflecting the transition of the U.S. population from a younger to an older age structure by 2010 (and beyond). Though some regions were, are, and should remain younger or older than others, Table 10 (p. 49) shows all regions with roughly comparable proportions of their populations in a given age category in the same year. In 1970, for example, about a third of the persons in each region were under age 18, and about a tenth were over age 65. By 2010, somewhat more than a fifth and roughly a seventh of every region's population would be in these respective categories.

How the Population Projections Were Derived

Population estimates, such as those cited above for intercensal years, incorporate current data on fertility, mortality, and migration into data from a previous census or an earlier estimate. In other words, estimates use mathematical formulas to move a population forward from an earlier time to the present. Population projections, using similar formulas, advance a population to a future date or dates.[25]

The State population projections developed by the Census Bureau[26] and presented here were derived by the commonly used cohort-component method. In this method, each component of population change—births, deaths, internal migration, and international migration—is projected separately for each birth cohort (or, group of persons born in a given year).[27] "Year-to-year effects of the individual components of [population] change . . . are taken into account for each age and sex group and then combined to produce the new age-sex groups for the next time period."[28] Thus, to arrive at the population of males aged 10 through 14 years five years from now, "we begin with those aged 5–9 today, deduct the number of deaths expected in that group, and add or subtract the amount of net migration . . . ."[29]

The basic formula for the cohort-component method used to generate the State projections is:

$$P_1 = P_0 + B - D + DIM - DOM + IIM - IOM,$$

where:

P_1 = population size at the end of the period;

P_0 = population size at the beginning of the period;

B = births during the period;

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[25] Haub, Carl. *Understanding Population Projections. Population Bulletin*, v. 42, no. 4. Washington, Population Reference Bureau, 1987. p. 7.

[26] U.S. Bureau of the Census, *Projections of the Population of States.*

[27] Ibid., p. 11.

[28] Haub, *Understanding Population Projections*, p. 9.

[29] Ibid.

D = deaths during the period;

DIM = domestic in-migration (migration into a State from elsewhere in the United States) during the period;

DOM = domestic out-migration (migration out of a State to other parts of the country) during the period;

IIM = international in-migration (immigration to the State from abroad) during the period; and

IOM = international out-migration (emigration from the State to foreign countries) during the period. [30]

The assumptions about future levels of fertility, mortality, and immigration that underlie the State projections are generally consistent with those used to develop the national projections published in another Census Bureau report. [31] The State projections, however, must take into account internal as well as international migration and variations among States in fertility and mortality.

The base population (P_0) for the State projections is the Census Bureau's estimate of the resident U.S. population by State for July 1, 1986, disaggregated for each year of age and by sex. [32] To obtain a racial breakdown of this population, modified counts for each race were carried forward from the 1980 decennial census. [33]

Projected future births (B) depend on two factors: the projected number of women in the childbearing ages (here, ages 14 through 49), and an assumed rate at which they will give birth. [34] For the whole United States, the projections assume a slight increase in fertility, to an "ultimate level of 1.8 births per woman." [35] However, total fertility rates [36] and age patterns of childbearing vary from State to State. The State projections assume that these exist-

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[30] U.S. Bureau of the Census, *Projections of the Population of States*, p. 11.

[31] U.S. Bureau of the Census, *Projections of the Population of the United States*. Unlike the State projections used in this report, the national projections consist of 30 alternative series. The so-called "middle series" is the one most often utilized. (Ibid., p. 18.)

[32] U.S. Bureau of the Census. *State Population and Household Estimates, with Age, Sex, and Components of Change: 1981-86. Current Population Reports*, Series P-25, no. 1010. Washington, Govt. Print. Off., 1987. The resident population includes members of the Armed Forces stationed in the United States.

[33] U.S. Bureau of the Census, *Projections of the Population of States*, p. 12. The census counts for each race were modified to achieve consistency with Office of Management and Budget categories "because of differences in the reporting of race between the 1980 census and other sources of administrative data such as births and deaths."

[34] Ibid., p. 17.

[35] Ibid.

[36] The total fertility rate (TFR) is the average number of live births that a woman would have "during her lifetime if she were to pass through her childbearing years conforming to the age-specific fertility rates of a given year." (Haupt, Arthur, and Thomas T. Kane. *Population Handbook*. Washington, Population Reference Bureau, 1978. p. 59.) Defined another way, the TFR is the sum of age-specific birth rates (the number of live births per 1,000 women at each age throughout the childbearing years) for a particular year. The TFR is an artificial construct because it uses the age-specific fertility rates of different women (actual women) in the same year to describe the fertility of the same (hypothetical) woman in different years. Nevertheless, the TFR "is one of the most important fertility measures. It answers as nearly as possible the question: How many children are women having nowadays?" (Ibid., p. 20.)

The TFR is also one measure of the extent to which a population is replacing itself. In the United States today, a TFR of 2.1 is considered replacement-level fertility, that is, the average number of children necessary to replace both parents. (Ibid., p. 23.) The reason the U.S. population continues to increase, rather than decrease, with below-replacement fertility is twofold. First, the number of women in the childbearing ages is still so large (because these women belong to the baby boom cohorts), relative to the rest of the population, that their annual fertility more than offsets the number of people who die each year. Second, immigration adds substantial numbers to the population annually.

ing fertility differentials by State will remain constant throughout the projection cycle (the period covered by the projections). [37]

Projected mortality levels (D) "are consistent with the middle series mortality assumptions used in the national population projections," which "assume a slight increase in overall life expectancy," from 75.0 years in 1986 to 77.6 years in 2005 and 81.2 years in 2080. [38] The State projections also incorporate differences among States in life expectancy and assume that they will stay the same over the projection cycle. [39]

Because of relatively low fertility, longer life expectancy, and the aging of the large baby boom cohorts, the U.S. population is growing older. The middle series projects a median age of 33.0 years in 1990, 36.4 in 2000, and 38.9 in 2010. [40] Total numbers of deaths and percentages of all deaths that occur at advanced ages are projected to increase. The middle series mortality projections show deaths at age 85 and older, for example, increasing from 22 percent of all deaths in 1990 to 27 percent in 2000 and 31 percent in 2010. [41]

Because no single national data source provided annual figures on internal migration (DIM – DOM) with the necessary demographic and geographic breakdowns for constructing State-by-State migration projections, three complementary sources were chosen: the March supplements to the 1976, 1980, and 1981 Current Population Surveys (CPS); the 1980 decennial census; and Internal Revenue Service (IRS) tax returns for 1975 and 1976 to 1985 and 1986. The 1980 census provided inter-State migration data by age, race, and sex—not for single years, but for a five-year interval (1975 to 1980). CPS data were used to estimate average annual migration rates by single years of age for the same period. Tax records yielded information about annual inter-State migration flows and trends since this period. [42]

Unlike past State population projections, those cited here do not assume constant migration rates for the entire projection cycle. Rather, they utilize a set of changing State-to-State rates. [43]

The State projections assume that annual net international migration (IIM – IOM) will total 600,000 at the start of the projection cycle, will decrease to 500,000 by 1998, and will remain at the lower level through the rest of the cycle. [44] "This . . . assumption is composed of approximately 160,000 emigrants and 760,000 [legal and illegal] immigrants (decreasing to 660,000)." [45] The projected decrease reflects an assumed reduction (from 200,000 to 100,000 persons annually) in illegal immigration, due to the Immigration Reform and Control Act of 1986 (IRCA). [46]

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[37] U.S. Bureau of the Census, *Projections of the Population of States*, p. 17.
[38] Ibid., p. 12.
[39] Ibid.
[40] U.S. Bureau of the Census, *Projections of the Population of the United States*, p. 4.
[41] Ibid., p. 12-13.
[42] U.S. Bureau of the Census, *Projections of the Population of States*, p. 15.
[43] Ibid., p. 16-17.
[44] Ibid., p. 13.
[45] Ibid. The implementation of P.L. 101-649, the Immigration Act of 1990, could increase annual legal immigrant admissions, thereby affecting the accuracy of these projections. For further discussion, see p. 37 of this report.
[46] U.S. Bureau of the Census, *Projections of the Population of the United States*, p. 26.

Because all immigrants and most emigrants are foreign born, their distribution among States is assumed to be the same as the distribution of the foreign-born population (for immigrants, the foreign-born population who entered the United States between 1975 and 1980) in 1980 census data. [47]

The age, race, and sex composition of immigrants in the State projections is based on Immigration and Naturalization Service data for 1980 to 1985. That of emigrants is taken from "the existing pattern developed at the Census Bureau for the years 1960 to 1975." [48]

Limitations of the Projections

Population projections are useful analytical tools: they show what would happen if certain demographic assumptions were met. They do not say, and should not be construed as saying, that these assumptions will be met. In other words, projections are not predictions, despite their frequent misinterpretation as such. [49]

The chief limitation of population projections is, of course, that the components of population change are not perfectly predictable. Projections are only as accurate as the assumptions underlying them, and biomedical, behavioral, judicial, or legislative developments during the projection cycle can diminish the accuracy of the assumptions in ways unknown or unknowable when they were made. Generally, the shorter the projection cycle is, the less chance there is that intervening developments will invalidate the assumptions; hence, the more accurate the projections are likely to be.

As previously noted, the Census Bureau's State projections cited here assume a slight increase in the U.S. total fertility rate (TFR), to an "ultimate level of 1.8 births per woman." [50] The TFR declined steadily after the mid-1960s, reaching 2.0 in 1972 and a low of 1.7 in 1976. [51] For the past decade, the TFR has been stable, at approximately 1.8. [52] Provisional 1989 data from the National Center for Health Statistics (NCHS), however, show increases in various fertility measures. [53] Accordingly, 1989 was the first year since the end of the baby boom (1964) when the number of U.S. births totaled 4 million. [54] It is expected that when the final 1989 NCHS figures are released, the TFR will be between 1.9 and 2.0. [55] The reasons for higher fertility are not entirely clear, but one reason may be childbearing by women of the baby boom cohorts who postponed births during the 1970s and most of the 1980s. [56] Another factor may be immigration, because many immigrants are young enough to produce offspring. Whether the TFR will increase, decrease, or fluctuate around 1.8 over the period spanned by the projections is uncertain.

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[47] U.S. Bureau of the Census, *Projections of the Population of States*, p. 13-14.
[48] Ibid., p. 13.
[49] Otten, Alan L. Why Demographers Are Wrong Almost as Often as Economists. *Wall Street Journal*, Jan. 29, 1985, p. 35.
[50] U.S. Bureau of the Census, *Projections of the Population of States*, p. 17.
[51] Haupt, Arthur. From the Editor's Desk. *Population Today*, v. 18, no. 5, May 1990. p. 2.
[52] Haub, *Understanding Population Projections*, p. 35.
[53] National Center for Health Statistics. *Monthly Vital Statistics Report*, v. 38, no. 12.
[54] Ibid.
[55] Haupt, From the Editor's Desk, p. 2.
[56] Ibid.

A TFR only slightly higher or lower than assumed in the middle series national projections would translate to large differences in possible future size—over the long term—of the U.S. population. The national projections assume, as ultimate levels, a low TFR of 1.5, a middle TFR (already discussed) of 1.8, and a high TFR of 2.2. [57] These three alternative fertility series, combined with constant middle series mortality and net immigration levels, would result in a total population size of, respectively, 265, 268, or 272 million by 2000; 275, 283, or 293 million by 2010; and 219, 292, or 421 million by 2080, the last year of the projection cycle. [58] U.S. population growth would cease and a decline would occur after 2020 in the low fertility scenario, and after 2030 in the middle series. In the high series, which assumes a TFR just slightly above the 2.1 replacement level, the population would not stop growing. Viewed another way, the population would be 3 percent larger in 2000, 7 percent larger in 2010, and 93 percent larger in 2080, assuming the high, as opposed to the low, TFR. [59] However, over the short term—the next 20 years, which are the focus of subsequent reports in this volume—population size differences produced by a low, middle, or high TFR would be relatively small and confined exclusively to the childhood and adolescent age groups.

Demographers, it bears noting in a discussion of fertility assumptions, have already failed to predict both the baby boom and the steep fertility decline—the baby bust—that followed it. They anticipated a brief rise in births after World War II, but did not foresee that higher fertility (particularly as compared with births during the 1930s) would persist for more than a decade after the war. Nor did they envision lower fertility—the absence of an "echo" to the baby boom—in the 1970s. [60]

Regarding mortality, the extent of the negative effect of Acquired Immunodeficiency Syndrome (AIDS) on general life expectancy is difficult to predict, and so are the possible positive effects on longevity of biomedical advances. The middle series national projections assume "that it will be increasingly difficult to improve mortality conditions for the general population." This assumption "is conservative in the sense that it does not allow for other than steady incremental improvements in mortality from degenerative conditions for the elderly." [61]

Internal migration and immigration can greatly affect future population size and, hence, the accuracy of population projections. With respect to States, internal migration is the "most important and complex component of population change" and the one that usually "shows the greatest degree of fluctuation," but also the one for which "data are often the least timely and least comprehensive." [62] At the national level, international migration is the "most difficult component of population change to project with any accuracy." [63]

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[57] U.S. Bureau of the Census, *Projections of the Population of the United States*, p. 23, 129.
[58] Ibid., p. 16.
[59] Ibid.
[60] Population Reference Bureau. *U.S. Population: Where We Are; Where We're Going. Population Bulletin*, v. 37, no. 2. Washington, Population Reference Bureau, 1982. p. 7–8.
[61] U.S. Bureau of the Census, *Projections of the Population of the United States*, p. 24.
[62] U.S. Bureau of the Census, *Projections of the Population of States*, p. 14.
[63] U.S. Bureau of the Census, *Projections of the Population of the United States*, p. 25.

> One reason is that the level of immigration is so heavily influenced by changes in Federal legislation, the political environment, and the degree of enforcement of border control. Another is that emigration and undocumented immigration are almost entirely outside the bounds of our statistical system. Because changes in these factors are not particularly amenable to quantitative analysis, the assumption has always been made in [past] Census Bureau projections that trends in future international migration levels could not be predicted. [64] [Both the State and middle series national projections cited in this report depart from past Census Bureau practice insofar as they predict decreasing immigration.]

The sensitivity of national population projections to net immigration can be illustrated by showing what future U.S. population size would be with constant middle series fertility and mortality assumptions and different assumed net immigration levels. In the low net immigration series (300,000 persons added annually), the U.S. population as of 2000 would be 264 million; in the middle series (500,000 net annual additions), 268 million; and in the high series (800,000 net annual additions), 272 million. In 2010, the total population under these different scenarios would be 276, 283, or 291 million, respectively. By 2080, the total size would be, respectively, 266, 292, or 333 million. Thus, in the high, as contrasted with the low, net immigration series, the U.S. population would be 3 percent larger in 2000, 5 percent larger in 2010, and 25 percent larger in 2080. Whereas, in the low and middle series, the population would stop growing and begin to decline after 2030 (though it would still be larger than in 1990), it would continue to increase with high immigration. By 2080, assuming high immigration throughout the projection cycle, the population would be 32 percent larger than in 1990. [65]

One way to assess the accuracy of different projected immigration levels is to compare them with recent actual figures.

> The annual admissions number set by INA [the Immigration and Nationality Act] is 270,000 under the preference system plus immediate relatives of U.S. citizens, refugees and asylees who have adjusted to permanent resident status, and special immigrants. During FY88, a total of 643,025 immigrants were admitted into the U.S. . . . The total number of immigrants admitted in FY87 was 601,516; in FY86 was 601,708; and in FY85 was 570,009. The current level, therefore, may be characterized as approximately 600,000 immigrants annually. [66]

These figures refer, appropriately in their original context, only to legal immigration. They do not incorporate estimates of illegal immigration or of emigration, which are, as previously noted, largely outside the bounds of the Federal statistical system. [67] If, borrowing from the population projections, the middle series net immigration assumptions of declining illegal immigration (falling from 200,000 to 100,000 annually by 1998) and 160,000 emigrants yearly were applied to the current annual legal immigration level

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[64] Ibid., p. 25–26.

[65] Ibid., p. 13. The reader may note differences between the possibilities for future U.S. population size presented in this paragraph and those given on p. 37. The differences exist because the discussion in this paragraph assumes constant fertility and mortality with varying net immigration, while the preceding discussion assumes constant mortality and net immigration with varying fertility.

[66] U.S. Library of Congress. Congressional Research Service. *Analytic and Policy Perspectives on Legal Immigration.* CRS Report for Congress No. 90-260 EPW, by Ruth Ellen Wasem. Washington, May 21, 1990. p. 4.

[67] U.S. Bureau of the Census, *Projections of the Population of the United States,* p. 25.

of about 600,000 annually, the resulting estimate of annual net immigration (total legal immigrant admissions + illegal immigration − emigration) would be 640,000 (decreasing to 540,000), roughly comparable to the middle series immigration projections.

However, new Federal legislation could substantially alter total legal immigrant admissions. P.L. 101-649, the Immigration Act of 1990, was signed by President George Bush on November 29, 1990.

> P.L. 101-649 provides for a permanent annual level of at least 675,000 immigrants beginning in FY 1995, preceded by a transition level of approximately 700,000 during FY 1992 through FY 1994. Refugees are the only major group of aliens not included. The permanent immigrant level of at least 675,000 consists of the following components:
>
> - 480,000 family-related immigrants;
> - 140,000 employment-based immigrants; and
> - 55,000 diversity immigrants. [68]

Actual levels of family-related immigration (and, hence, of permanent annual immigration) remain to be seen. Immediate relatives of U.S. citizens (spouses and unmarried minor children, plus parents of adult U.S. citizens) are numerically unrestricted, but:

> the number of family-sponsored preference visas [visas granted to categories of family members other than immediate relatives] is reduced each fiscal year by the number of immediate relative visas issued the previous year, not to fall below a floor of 226,000. The family level of 480,000 will be exceeded if necessary to maintain the 226,000 floor on family-sponsored preference visas. [69]

Increased immigration would have the greatest effects on States where immigrants cluster. Almost four-fifths of the more than one million persons granted immigrant status in FY 1989 intended to reside in just six States: California (42 percent), New York (12 percent), Texas (10 percent), Illinois (6 percent), Florida (4 percent), and New Jersey (4 percent). [70] These "have been the leading states of intended residence for new immigrants every year since 1971. California has been the leading state of residence every year since 1976 . . . ." [71] Growth could be expected in these States not only from the immigrants themselves, but also, because they tend to be relatively young, from their future progeny. Thus, over the next 20 years, immigration could especially augment the preschool, school-age, and younger working-age populations of the major receiving States.

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[68] U.S. Library of Congress. Congressional Research Service. *Immigration Act of 1990 (P.L. 101-649).* CRS Report for Congress No. 90-601 EPW, by Joyce C. Vialet and Larry M. Eig. Washington, Dec. 14, 1990. p. 2.

[69] Ibid.

[70] U.S. Immigration and Naturalization Service, *Statistical Yearbook, 1989,* p. 35.

[71] Ibid., p. xxi.

FIGURE 1. Four Regions and Nine Divisions of the United States

TABLE 1. U.S. Population Change by Regions, Divisions, and States, 1980–1990

(numbers in thousands)

	Population[a]		Change 1980–1990	
	1980	1990	Number	Percent
Total	226,546	248,710	22,164	9.8
REGIONS				
Northeast	49,135	50,809	1,674	3.4
Midwest	58,866	59,669	803	1.4
South	75,372	85,446	10,074	13.4
West	43,172	52,786	9,614	22.3
DIVISIONS WITHIN REGIONS				
NORTHEAST				
New England	12,348	13,207	859	7.0
Middle Atlantic	36,787	37,602	815	2.2
MIDWEST				
East North Central	41,682	42,009	327	0.8
West North Central	17,183	17,660	477	2.8
SOUTH				
South Atlantic	36,959	43,567	6,608	17.9
East South Central	14,666	15,176	510	3.5
West South Central	23,747	26,703	2,956	12.4
WEST				
Mountain	11,373	13,659	2,286	20.1
Pacific	31,800	39,127	7,327	23.0
STATES WITHIN DIVISIONS				
NEW ENGLAND				
Maine	1,125	1,228	103	9.2
New Hampshire	921	1,109	188	20.4
Vermont	511	563	52	10.2
Massachusetts	5,737	6,016	279	4.9
Rhode Island	947	1,003	56	5.9
Connecticut	3,108	3,287	179	5.8
MIDDLE ATLANTIC				
New York	17,558	17,990	432	2.5
New Jersey	7,365	7,730	365	5.0
Pennsylvania	11,864	11,882	18	0.2
EAST NORTH CENTRAL				
Ohio	10,798	10,847	49	0.5
Indiana	5,490	5,544	54	1.0
Illinois	11,427	11,431	4	0.0
Michigan	9,262	9,295	33	0.4
Wisconsin	4,706	4,892	186	4.0
WEST NORTH CENTRAL				
Minnesota	4,076	4,375	299	7.3
Iowa	2,914	2,777	−137	−4.7
Missouri	4,917	5,117	200	4.1
North Dakota	653	639	−14	−2.1
South Dakota	691	696	5	0.7
Nebraska	1,570	1,578	8	0.5
Kansas	2,364	2,478	114	4.8
SOUTH ATLANTIC				
Delaware	594	666	72	12.1
Maryland	4,217	4,781	564	13.4
District of Columbia	638	607	−31	−4.9
Virginia	5,347	6,187	840	15.7
West Virginia	1,950	1,793	−157	−8.1
North Carolina	5,882	6,629	747	12.7
South Carolina	3,122	3,487	365	11.7
Georgia	5,463	6,478	1,015	18.6

TABLE 1. U.S. Population Change by Regions, Divisions, and States, 1980–1990—Continued

(numbers in thousands)

	Population*		Change 1980–1990	
	1980	1990	Number	Percent
Florida	9,746	12,938	3,192	32.8
EAST SOUTH CENTRAL				
Kentucky	3,661	3,685	24	0.7
Tennessee	4,591	4,877	286	6.2
Alabama	3,894	4,041	147	3.8
Mississippi	2,521	2,573	52	2.1
WEST SOUTH CENTRAL				
Arkansas	2,286	2,351	65	2.8
Louisiana	4,206	4,220	14	0.3
Oklahoma	3,025	3,146	121	4.0
Texas	14,229	16,987	2,758	19.4
MOUNTAIN				
Montana	787	799	12	1.5
Idaho	944	1,007	63	6.7
Wyoming	470	454	−16	−3.4
Colorado	2,890	3,294	404	14.0
New Mexico	1,303	1,515	212	16.3
Arizona	2,718	3,665	947	34.8
Utah	1,461	1,723	262	17.9
Nevada	800	1,202	402	50.3
PACIFIC				
Washington	4,132	4,867	735	17.8
Oregon	2,633	2,842	209	7.9
California	23,668	29,760	6,092	25.7
Alaska	402	550	148	36.8
Hawaii	965	1,108	143	14.8

* Population figures in this and all subsequent tables refer to the resident population (civilian plus Armed Forces) living in the total United States, regions, divisions, or States.

SOURCES: The 1980 decennial census population figures are from: U.S. Bureau of the Census. *Projections of the Population of States, by Age, Sex, and Race: 1988 to 2010.* *Current Population Reports*, Series P-25, no. 1017. Washington, Govt. Print. Off., 1988. p. 20–21. The 1990 decennial census population figures are from: U.S. Bureau of the Census. *Commerce News: U.S. Population Up Nearly Two-Thirds in 40 Years, Nevada, California Lead 40-Year Period Growth.* CB91-07. Washington, Jan. 7, 1991. p. 6.

TABLE 2. U.S. Population by Regions and Divisions, 1970–2010

(in thousands)

Year	1970	1980	1990	2000*	2010*
Total	203,302	226,546	248,710	267,747	282,055
REGIONS					
Northeast	49,061	49,135	50,809	51,810	52,496
Midwest	56,590	58,866	59,669	59,596	59,018
South	62,813	75,372	85,446	96,919	104,919
West	34,838	43,172	52,786	59,422	65,622
DIVISIONS WITHIN REGIONS					
NORTHEAST					
New England	11,847	12,348	13,207	13,775	14,243
Middle Atlantic	37,213	36,787	37,602	38,035	38,253
MIDWEST					
East North Central	40,263	41,682	42,009	41,746	41,111
West North Central	16,328	17,183	17,660	17,850	17,907
SOUTH					
South Atlantic	30,679	36,959	43,567	50,002	55,110
East South Central	12,808	14,666	15,176	16,285	16,847
West South Central	19,326	23,747	26,703	30,632	32,961
WEST					
Mountain	8,290	11,373	13,659	16,022	17,679
Pacific	26,548	31,800	39,127	43,400	47,943

* Projections.

SOURCES: U.S. Bureau of the Census. *Projections of the Population of States, by Age, Sex, and Race: 1988 to 2010. Current Population Reports*, Series P-25, no. 1017. Washington, Govt. Print. Off., 1988. p. 20–21. *State Population and Household Estimates to 1985, with Age and Components of Change. Current Population Reports*, Series P-25, no. 998. Washington, Govt. Print. Off., 1986. p. 39. The 1990 decennial census population figures are from: U.S. Bureau of the Census. *Commerce News: U.S. Population Up Nearly Two-Thirds in 40 Years; Nevada, California Lead 40-Year Period Growth*. CB91-07. Washington, Jan. 7, 1991. p. 6.

TABLE 3. Percentage Change in U.S. Population by Regions and Divisions, 1970–2010

Time Period	1970–1980	1980–1990	1990–2000*	2000–2010*
Total	11.4	9.8	7.2	5.3
REGIONS				
Northeast	0.2	3.4	2.4	1.3
Midwest	4.0	1.4	−0.3	−1.0
South	20.0	13.4	11.1	8.3
West	23.9	22.3	13.7	10.4
DIVISIONS WITHIN REGIONS				
NORTHEAST				
New England	4.2	7.0	5.3	3.4
Middle Atlantic	−1.1	2.2	1.4	0.6
MIDWEST				
East North Central	3.5	0.8	−0.7	−1.5
West North Central	5.2	2.8	0.7	0.3
SOUTH				
South Atlantic	20.5	17.9	14.3	10.2
East South Central	14.5	3.5	4.4	3.5
West South Central	22.9	12.4	9.7	7.6
WEST				
Mountain	37.2	20.1	14.5	10.3
Pacific	19.8	23.0	13.4	10.5

* Projections.

SOURCE: Computed from Table 2.

TABLE 4. Ten States with Greatest Numerical Population Increases, Showing Net Migration, 1970–1988

(in thousands)

Time Period and State	Population Increase	Net Migration [a]	Time Period and State	Population Increase	Net Migration [a]
1970–1980			1980–1988 [b]		
California	3,697	1,573	California	4,646	2,516
Texas	3,031	1,481	Texas	2,612	1,117
Florida	2,955	2,519	Florida	2,588	2,270
Arizona	943	656	Georgia	879	488
Georgia	875	329	Arizona	771	501
North Carolina	797	278	Virginia	668	345
Washington	719	388	North Carolina	607	311
Virginia	695	239	Washington	516	219
Colorado	680	385	Colorado	411	133
Tennessee	665	297	Maryland	405	155

[a] Net migration includes both inter-State and international movements.

[b] The 10 States with the greatest increases from 1980 to 1990 (in thousands) were: California, 6,092; Florida, 3,192; Texas, 2,758; Georgia, 1,015; Arizona, 947; Virginia, 840; North Carolina, 747; Washington, 735; Maryland, 564; and New York, 432. Colorado's increase (in thousands) was 404. The 1990 rankings were derived from data in Table 1.

SOURCE: U.S. Bureau of the Census. *State Population and Household Estimates, with Age, Sex, and Components of Change: 1981–88. Current Population Reports*, Series P–25, no. 1044. Washington, Govt. Print. Off., 1989. p. 4.

TABLE 5. Ten States with Greatest Percentage Population Increases, Showing Net Migration Rates, 1970–1988

Time Period and State	Percentage Increase	Net Migration Rate	Time Period and State	Percentage Increase	Net Migration Rate
1970–1980			1980–1988 [a]		
Nevada	63.8	49.7	Nevada	31.7	23.4
Arizona	53.1	37.0	Alaska	30.5	10.6
Florida	43.5	37.1	Arizona	28.4	18.4
Wyoming	41.3	25.5	Florida	26.6	23.3
Utah	37.9	11.2	California	19.6	10.6
Alaska	32.8	9.3	Texas	18.4	7.8
Idaho	32.4	15.4	New Hampshire	17.9	11.8
Colorado	30.8	17.4	Georgia	16.1	8.9
New Mexico	28.1	11.4	Utah	15.7	−1.3
Texas	27.1	13.2	New Mexico	15.6	4.4

[a] The 10 States with the greatest percentage increases from 1980 to 1990 were: Nevada, 50.3; Alaska, 36.8; Arizona, 34.8; Florida, 32.8; California, 25.7; New Hampshire, 20.4; Texas, 19.4; Georgia, 18.6; Utah, 17.9; and Washington, 17.8. New Mexico's increase was 16.3 percent for the decade. The 1990 rankings were derived from data in Table 1.

SOURCE: See Table 4.

TABLE 6. U.S. Population Change and Net Migration by Regions, Divisions, and States, 1980–1988

(numbers in thousands)

	Population Change		Net Migration	
	Number	Percent	Number	Rate
Total	19,261	8.5	5,587	2.5
REGIONS AND DIVISIONS				
NORTHEAST	1,459	3.0	−306	−0.6
New England	615	5.0	130	1.1
Middle Atlantic	845	2.3	−435	−1.2
MIDWEST	1,012	1.7	−2,159	−3.7
East North Central	437	1.0	−1,784	−4.3
West North Central	575	3.3	−375	−2.2
SOUTH	9,283	12.3	4,511	6.0
South Atlantic	5,467	14.8	3,575	9.7
East South Central	678	4.6	−50	−0.3
West South Central	3,138	13.2	986	4.2
WEST	7,506	17.4	3,540	8.2
Mountain	1,955	17.2	747	6.6
Pacific	5,551	17.5	2,794	8.8
STATES WITHIN DIVISIONS				
NEW ENGLAND				
Maine	81	7.2	33	3.0
New Hampshire	165	17.9	109	11.8
Vermont	46	9.0	18	3.5
Massachusetts	15	22.7	−46	−0.8
Rhode Island	46	4.8	17	1.8
Connecticut	126	4.0	0	0.0
MIDDLE ATLANTIC				
New York	35	12.0	−343	−2.0
New Jersey	35	64.8	80	1.1
Pennsylvania	13	71.2	−172	−1.5
EAST NORTH CENTRAL				
Ohio	57	0.5	−466	−4.3
Indiana	66	1.2	−211	−3.9
Illinois	187	1.6	−469	−4.1
Michigan	−22	−0.2	−524	−5.7
Wisconsin	149	3.2	−113	−2.4
WEST NORTH CENTRAL				
Minnesota	231	5.7	−40	−1.0
Iowa	−80	−2.7	−204	−7.0
Missouri	224	4.6	7	0.1
North Dakota	14	2.2	−37	−5.6
South Dakota	22	3.2	−25	−3.6
Nebraska	32	2.1	−59	−3.8
Kansas	131	5.6	−17	−0.7
SOUTH ATLANTIC				
Delaware	66	11.1	31	5.3
Maryland	405	9.6	155	3.7
District of Columbia	−21	−3.4	−44	−6.9
Virginia	668	12.5	345	6.4
West Virginia	−73	−3.8	−122	−6.3
North Carolina	607	10.3	311	5.3
South Carolina	348	11.2	142	4.5
Georgia	879	16.1	488	8.9
Florida	2,588	26.6	2,270	23.3
EAST SOUTH CENTRAL				
Kentucky	66	1.8	−101	−2.8
Tennessee	304	6.6	103	2.3
Alabama	209	5.4	14	0.3

TABLE 6. U.S. Population Change and Net Migration by Regions, Divisions, and States, 1980–1988—Continued

(numbers in thousands)

	Population Change		Net Migration	
	Number	Percent	Number	Rate
Mississippi	99	3.9	−66	−2.6
WEST SOUTH CENTRAL				
Arkansas	108	4.7	12	0.5
Louisiana	202	4.8	−162	−3.9
Oklahoma	217	7.2	19	0.6
Texas	2,612	18.4	1,117	7.8
MOUNTAIN				
Montana	18	2.3	−39	−5.0
Idaho	59	6.2	−31	−3.3
Wyoming	10	2.1	−43	−9.2
Colorado	411	14.2	133	4.6
New Mexico	204	15.6	57	4.4
Arizona	771	28.4	501	18.4
Utah	229	15.7	−18	−1.3
Nevada	254	31.7	187	23.4
PACIFIC				
Washington	516	12.5	219	5.3
Oregon	133	5.1	−10	−0.4
California	4,646	19.6	2,516	10.6
Alaska	123	30.5	42	10.6
Hawaii	134	13.8	26	2.7

SOURCE: U.S. Bureau of the Census. *State Population and Household Estimates, with Age, Sex, and Components of Change: 1981–88. Current Population Reports*, Series P–25, no. 1044. Washington, Govt. Print. Off., 1989, p. 13.

TABLE 7. Ten Top-Ranked States in Projected Population Size, 1990–2010

(in thousands)

Year and State	Population	Year and State	Population	Year and State	Population
1990		2000		2010	
California	29,760	California	33,500	California	37,347
New York	17,990	Texas	20,211	Texas	22,281
Texas	16,987	New York	17,986	New York	18,139
Florida	12,938	Florida	15,415	Florida	17,530
Pennsylvania	11,882	Illinois	11,580	Illinois	11,495
Illinois	11,431	Pennsylvania	11,503	Pennsylvania	11,134
Ohio	10,847	Ohio	10,629	Ohio	10,397
Michigan	9,295	Michigan	9,250	Michigan	9,097
New Jersey	7,730	New Jersey	8,546	Georgia	9,045
North Carolina	6,629	Georgia	7,957	New Jersey	8,980

SOURCE: U.S. Bureau of the Census. *Projections of the Population of States, by Age, Sex, and Race: 1988 to 2010.* Current Population Reports, Series P-25, no. 1017. Washington, Govt. Print. Off., 1988. p. 4. The 1990 decennial census population figures are from Table 1.

TABLE 8. Ten States with Greatest Projected Percentage Gains or Losses of Population, 1990–2010

Time Period and State	Percentage Change	Time Period and State	Percentage Change
1990–2000		2000–2010	
Arizona	23.1	Hawaii	15.9
Nevada	21.1	Arizona	15.2
New Mexico	20.6	New Mexico	14.2
Florida	20.3	Nevada	13.9
Georgia	19.4	Florida	13.7
Alaska	19.3	Georgia	13.7
Hawaii	17.9	California	11.5
New Hampshire	16.7	Alaska	11.4
California	15.0	Texas	10.2
Texas	14.1	New Hampshire	9.2
Iowa	−7.6	Iowa	−6.6
West Virginia	−7.2	West Virginia	−6.1
North Dakota	−4.7	Pennsylvania	−3.2
Pennsylvania	−2.7	North Dakota	−2.9
Wyoming	−2.6	Ohio	−2.2
Nebraska	−2.0	Nebraska	−1.7
Ohio	−1.5	Indiana	−1.7
Montana	−1.4	Michigan	−1.7
Indiana	−0.9	Wisconsin	−1.5
Wisconsin	−0.5	Illinois	−0.7

SOURCE: U.S. Bureau of the Census. *Projections of the Population of States, by Age, Sex, and Race: 1988 to 2010.* Current Population Reports, Series P-25, no. 1017. Washington, Govt. Print. Off., 1988. p. 6.

TABLE 9. U.S. Population by Age Categories and Regions, 1970–2010

(in thousands)

Year and Region	Age Category						
	0–17	18–24	25–34	35–44	45–64	65+	Total
1970							
Northeast	16,041	5,348	5,852	5,729	10,915	5,176	49,061
Midwest	19,855	6,452	6,787	6,290	11,502	5,704	56,590
South	21,852	7,643	7,725	7,065	12,511	6,017	62,813
West	11,958	4,288	4,565	4,023	6,922	3,082	34,838
Total	69,707	23,728	24,930	23,107	41,850	19,980	203,302
1980							
Northeast	13,083	6,163	7,707	5,580	10,531	6,072	49,135
Midwest	16,918	7,872	9,427	6,474	11,483	6,692	58,866
South	21,638	10,065	12,215	8,526	14,440	8,488	75,372
West	12,116	5,922	7,732	5,055	8,049	4,298	43,172
Total	63,755	30,022	37,082	25,635	44,503	25,549	226,546
1990 *							
Northeast	11,900	5,123	8,719	7,581	10,167	7,089	50,577
Midwest	15,607	6,112	10,374	8,829	11,121	7,735	59,777
South	22,622	9,248	15,101	13,031	16,329	10,946	87,276
West	13,908	5,415	9,535	8,386	9,228	5,789	52,261
Total	64,037	25,897	43,728	37,827	46,843	31,560	249,891
2000 *							
Northeast	12,007	4,421	7,184	8,670	12,179	7,348	51,810
Midwest	14,988	5,535	7,955	9,671	13,535	7,914	59,596
South	23,668	9,226	13,252	15,698	22,266	12,809	96,919
West	15,049	5,806	8,562	9,801	15,394	6,812	59,422
Total	65,713	24,987	36,952	43,841	61,374	34,882	267,747
2010 *							
Northeast	11,001	4,777	6,818	7,216	15,012	7,674	52,496
Midwest	13,504	5,669	7,649	7,534	16,401	8,262	59,018
South	23,043	10,013	13,622	13,658	29,432	15,150	104,919
West	15,098	6,452	9,287	8,724	17,786	8,277	65,622
Total	62,646	26,911	37,375	37,131	78,630	39,362	282,055

* Projections.

SOURCES: U.S. Bureau of the Census. *Projections of the Population of States, by Age, Sex, and Race: 1988 to 2010. Current Population Reports*, Series P-25, no. 1017. Washington, Govt. Print. Off., 1988. p. 29–42. *State Population and Household Estimates to 1985, with Age and Components of Change. Current Population Reports*, Series P-25, no. 998. Washington, Govt. Print. Off., 1986. p. 39. U.S. Bureau of the Census. *State Population and Household Estimates: with Age, Sex, and Components of Change: 1981–88. Current Population Reports*, Series P-25, no. 1044. Washington, Govt. Print. Off., 1989. p. 20–29. The 1990 figures are from population projections, not from the 1990 decennial census, because the census data are not yet available by age category.

Columns and rows may not sum to totals because of independent rounding by the Census Bureau.

TABLE 10. Percentage Distribution of U.S. Population by Age Categories and Regions, 1970–2010

Year and Region	Age Category						
	0–17	18–24	25–34	35–44	45–64	65+	Total
1970							
Northeast	32.7	10.9	11.9	11.7	22.3	10.6	100.1
Midwest	35.1	11.4	12.0	11.1	20.3	10.1	100.0
South	34.8	12.2	12.3	11.3	19.9	9.6	100.1
West	34.3	12.3	13.1	11.6	19.9	8.9	100.1
Total	34.3	11.7	12.3	11.4	20.6	9.8	100.1
1980							
Northeast	26.6	12.5	15.7	11.4	21.4	12.4	100.0
Midwest	28.7	13.4	16.0	11.0	19.5	11.4	100.0
South	28.7	13.4	16.2	11.3	19.2	11.3	100.1
West	28.1	13.7	17.9	11.7	18.6	10.0	100.0
Total	28.1	13.3	16.4	11.3	19.6	11.3	100.0
1990 *							
Northeast	23.5	10.1	17.2	15.0	20.1	14.0	99.9
Midwest	26.1	10.2	17.4	14.8	18.6	12.9	100.0
South	25.9	10.6	17.3	14.9	18.7	12.5	99.9
West	26.6	10.4	18.2	16.1	17.7	11.1	100.1
Total	25.6	10.4	17.5	15.1	18.8	12.6	100.0
2000 *							
Northeast	23.2	8.5	13.9	16.7	23.5	14.2	100.0
Midwest	25.2	9.3	13.4	16.2	22.7	13.3	100.1
South	24.4	9.5	13.7	16.2	23.0	13.2	100.0
West	25.3	9.8	14.4	16.5	22.5	11.5	100.0
Total	24.5	9.3	13.8	16.4	22.9	13.0	99.9
2010 *							
Northeast	21.0	9.1	13.0	13.8	28.6	14.6	100.1
Midwest	22.9	9.6	13.0	12.8	27.8	14.0	100.1
South	22.0	9.5	13.0	13.0	28.1	14.4	100.0
West	23.0	9.8	14.2	13.3	27.1	12.6	100.0
Total	22.2	9.5	13.3	13.2	27.9	14.0	100.1

* Projections.
SOURCE: Computed from Table 9.

TABLE 11. Percentage Change in U.S. Population by Age Categories and Regions, 1970–2010

Time Period and Region	Age Category						
	0–17	18–24	25–34	35–44	45–64	65+	Total
1970–1980							
Northeast	−18.4	15.2	31.7	−2.6	−3.5	17.3	0.2
Midwest	−14.8	22.0	38.9	2.9	−0.2	17.3	4.0
South	−1.0	31.7	58.1	20.7	15.4	41.1	20.0
West	1.3	38.1	69.4	25.7	16.3	39.5	23.9
Total	−8.5	26.5	48.7	10.9	6.3	27.9	11.4
1980–1990 *							
Northeast	−9.0	−16.9	13.1	35.9	−3.5	16.8	2.9
Midwest	−7.8	−22.4	10.1	36.4	−3.2	15.6	1.6
South	4.6	−8.1	23.6	52.8	13.1	29.0	15.8
West	14.8	−8.6	23.3	65.9	14.7	34.7	21.1
Total	0.4	−13.7	17.9	47.6	5.3	23.5	10.3
1990–2000 *							
Northeast	0.9	−13.7	−17.6	14.4	19.8	3.7	2.4
Midwest	−4.0	−9.4	−23.3	9.5	21.7	2.3	−0.3
South	4.6	−0.2	−12.2	20.5	36.4	17.0	11.0
West	8.2	7.2	−10.2	16.9	45.2	17.7	13.7
Total	2.6	−3.5	−15.5	15.9	31.0	10.5	7.2
2000–2010 *							
Northeast	−8.4	8.1	−5.1	−16.8	23.4	4.4	1.3
Midwest	−9.9	2.4	−3.9	−22.1	21.2	4.4	−1.0
South	−2.6	8.5	2.8	−13.0	32.2	18.3	8.3
West	0.3	11.1	8.5	−11.0	32.8	21.5	10.4
Total	−4.7	7.7	1.1	−15.3	28.1	12.8	5.3

* Projections
SOURCE: Computed from Table 9

III. DEMOGRAPHY AND THE LABOR FORCE IN THE 1990s

by Linda Levine *

The size, growth, and composition of the future labor force are largely dependent upon the size, growth, and composition of the current U.S. population. Demography is destiny, to paraphrase *Workforce 2000: Work and Workers for the Twenty-first Century*, a book often credited with launching the labor force issues of the coming years. [1] While this may overstate the case somewhat, as intervening events could produce different scenarios, some proportion of today's population will assuredly become tomorrow's labor force.

Future Growth of the Labor Force

The baby-boom generation, the large population cohorts born after World War II (1946–1964), has had a tremendous effect on the economy during the past several decades and will continue to do so in future years. After the surge in births created a shortage of maternity beds and four bedroom homes in the suburbs during the 1950s as well as increased demand for public school facilities in the 1960s, many of the baby boomers entered the labor force in the 1970s when they "sorely tested the economy's ability to create jobs for young adults." [2] As shown in Table 1, the labor force added more than 24 million workers during the 1970s, for an annual average growth rate of 2.6 percent.

During the 1980s, the baby-bust generation began to follow the baby boomers into the labor force. This smaller population group is the result of lower birth rates between 1965 and 1978. The baby-bust cohort's entrance into the labor force expanded it by only about 15 million workers from 1980 to 1988, for an annual average increase of 1.6 percent. At the same time, the size of the youth labor force (i.e., 16–24 year olds) actually shrank by almost 3 million workers, for an annual average decrease of 1.4 percent.

The slowdown in the rate of labor force growth is projected to continue through the 1990s. In its most recent projections, the U.S. Bureau of Labor Statistics (BLS) estimated that the labor force will grow from 1988 to 2000 at an annual average rate of only 1.2 percent.[3] (See Table 1.) Although this slow growth rate would add

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[1] Johnston, William B. and Arnold E. Packer. *Workforce 2000: Work and Workers for the Twenty-first Century*. Wash., U.S. Govt. Print. Off., 1987. 117p.

[2] Commission of Workforce Quality and Labor Market Efficiency. *Investing in People: A Strategy to Address America's Workforce Crisis*. Background Papers, vols. I & II. Wash., U.S. Govt. Print. Off., Sept. 1989. p. 1073.

[3] Fullerton, Howard N., Jr. New Labor Force Projections, Spanning 1988 to 2000. *Monthly Labor Review*, Nov. 1989. p. 7.

TABLE 1. Size and Growth of the Labor Force

(moderate-growth projection to 2000)

	1970	1980	1988	2000
Total (in thousands)	82,771	106,940	121,669	141,134
16–24 years old	17,846	25,300	22,535	22,456
25–54 years old	50,421	66,600	84,041	101,267
55 years or older	14,505	15,039	15,094	17,411
	1970–1980	1980–1988	1988–2000	
Growth rates (average annual percent change)				
16 years or older	2.6	1.6	1.2	
16–24 years old	3.6	−1.4	0.0	
25–54 years old	2.8	3.0	1.6	
55 years or older	0.4	0.0	1.2	

Source: Fullerton, Howard N. Jr. New Labor Force Projections, Spanning 1988 to 2000. *Monthly Labor Review*, Nov. 1989. p. 7.

nearly 20 million people to the job market, it would be a percentage increase less than half that of the 1970s.

The labor force is expected to continue growing slowly until well into the 21st century. According to the Population Reference Bureau, "Even projections that use fairly pessimistic assumptions about economic and population growth show that the labor force is not likely to decline in size until sometime after 2020," when the baby boomers are in their retirement years. [4]

ASSUMPTIONS UNDERLYING THE FORECAST

The BLS' moderate-growth projection of the labor force is based partly upon assumptions underlying the middle-growth population series of the U.S. Bureau of the Census, and upon additional assumptions about future patterns of labor force participation. The Census Bureau's assumptions relate to fertility, mortality, and net immigration. Although the fertility assumption is quite important for population projections, it does not affect the size of the working-age population in 2000 because these individuals have already been born. Changes in mortality likewise have a limited influence on the size of the working-age population by 2000.

Immigration

The immigration assumption is quite important to the accuracy of labor force forecasts. It is probably among the most problematic assumptions to make, however. To the extent that the immigration assumption does not track fairly closely the actual trend of future years, then the labor force projections could be considerably off of the mark.

The Census Bureau's middle-growth population projection assumes that documented immigrants (including refugees) will number 560,000 annually, and emigrants, 160,000 annually. Undocumented (i.e., illegal) immigrants are projected to fall from 200,000 in 1988 to 100,000 in 1998 because of the anticipated effect of the Immigration Reform and Control Act (IRCA), which levies fines on

[4] Population Reference Bureau. *America in the 21st Century*. Wash., 1989. p. 8.

U.S. firms convicted of employing illegal aliens. Thus, net immigration is projected to *decline* from 600,000 in 1988 to 500,000 in 1998. [5]

Legislation now pending in both Houses of Congress would *increase* the future level of legal immigration. Moreover, it is too early to tell whether IRCA will succeed in its goal of reducing illegal immigration. Unforeseen events in future years, such as heightened international unrest, could increase the number of refugees and illegal aliens who would want to enter the United States.

Labor Force Participation

Another important assumption that underpins labor force projections concerns the future path of labor force participation rates. The labor force participation rate is the proportion of the civilian noninstitutional population aged 16 or older that is in the labor force (i.e., either employed or looking for work).

As with the immigration assumption, it can be difficult to predict labor force behavior accurately. For example, the BLS projects that young women's work activity will continue to rise, but that it will rise more slowly as it has since the mid-1980s. Between 1985 and 1988, the rate of increase in labor force participation among women 20–34 years old dropped by more than half of its rate of increase between the mid-1970s and mid-1980s. [6] This slowdown could indicate that young women of childbearing age may be approaching their maximum degree of work activity, perhaps, according to the BLS, because of difficulties associated with arranging for child care.

In its latest forecast, the BLS projects that the overall rate of increase in women's work activity will slow through the 1990s because their labor force participation rate already is quite high compared to past levels. [7] In 1989, 57.4 percent of the female population at least 16 years of age was in the labor force—a record high. Before 1978, little more than 10 years earlier, women's labor force participation rate had been under 50 percent. [8]

There are several reasons why the BLS' projection of a slowing in women's work activity could diverge from future reality. The projection might err on the low side because welfare reforms could reduce work disincentives for poor women who head families and because higher earnings for all women could encourage more of them to enter the labor force. Improved child care services, as well as more flexible leave policies and work schedules, also might prompt the acceleration of women's labor force participation. According to economist Nancy Barrett:

> Throughout the 1970s, the Bureau of Labor Statistics and most other forecasters consistently underestimated the strength of the transition in women's labor force roles. Evidence from other countries with more vigorous implementation of pay equity policies and with better household support services like child care and parental leave, suggests that the female

[5] Fullerton, New Labor Force Projections, p. 4.
[6] Ibid., p. 6.
[7] Kutscher, Ronald E. Projections Summary and Emerging Issues. *Monthly Labor Review*, Nov. 1989. p. 67.
[8] BLS. *Employment and Earnings*, Jan. 1990. p. 161.

labor force participation rate could reach as high as 70 percent with supportive policies in effect. [9]

Alternatively, the projection might err on the high side because as pension benefits for women improve, the rate of increase in older women's labor force participation could slow.

THE ACCURACY OF LABOR FORCE FORECASTS

Because of the uncertainty surrounding the assumptions that underlie labor force projections, the accuracy of forecasts will vary over time. Some observers who are skeptical of the accuracy of labor force forecasts note that the BLS' projections were closer to the mark for 1975 and 1980 than they were for 1985. [10]

Generally, past BLS forecasts understated the aggregate size and growth rate of the labor force. The discrepancies between projected and actual labor force trends were due to both the underlying population and participation rate assumptions. [11] In the case of the population assumption, net immigration was underestimated because in prior years the Census Bureau failed to account for undocumented aliens. As noted previously, the population assumption in the latest BLS labor force projection includes an estimate of illegal immigrants. The BLS also prepares two sets of projections in addition to its moderate-growth scenario. The two less widely used projections are based upon different assumptions about future trends in immigration and other variables. For example, the Census Bureau's high-growth assumption of net immigration rising from 600,000 in 1988 to 800,000 in 1998 was incorporated in the BLS' high-growth projection of the labor force for 2000. [12]

In the case of age-sex-race-specific participation rate assumptions, the increase in women's work activity usually was underestimated. The differences between projected and actual trends in women's labor force participation were related to deviations from other past trends, such as a declining fertility rate; a weakening of the relationship between the presence of young children and their mothers' labor force activity; an increase in women's educational attainment; and a marked slowdown in real income gains (with unemployment for many male workers), which likely prompted wives to increase their paid work effort to maintain their families' living standards and to compensate for the uncertainties of the time. [13]

Composition of the Future Labor Force

Regardless of the precise rate of labor force growth during the 1990s, it is clear that the mix of workers who will make up the labor force in future years will be different from today's. Relatively

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[9] U.S. Congress. Joint Economic Committee. *Employment in the Year 2000: A Candid Look at Our Future*. Senate Hearing No. 100-728, 100th Cong., 2nd Sess. Wash., U.S. Govt. Print. Off., 1988. p. 215-216.

[10] Levitan, Sar A. and Frank Gallo. The Shortsighted Focus on Labor Shortages. *Challenge*, Sept./Oct. 1989. p. 29.

[11] Fullerton, Howard N. An Evaluation of Labor Force Projections to 1985. *Monthly Labor Review*, Nov. 1988. p. 9-10, 12-14.

[12] Fullerton, New Labor Force Projections, p. 10.

[13] Fullerton, Howard N. How Accurate Were Projections of the 1980 Labor Force? *Monthly Labor Review*, July 1982. p. 17-19.

more workers in 2000 than at the present time will be women, minority group members, and middle-aged.

MORE WOMEN WORKERS

Even with an anticipated slowdown in the rate of increase in women's labor force participation, the proportion of women in the work force could rise somewhat, from 45 percent in 1988 to 47 percent in 2000. (See Table 2.) Although their respective growth rates are expected to converge over time, the male labor force likely will continue to expand much more slowly (0.9 percent annually) than the female labor force (1.7 percent annually) through the end of the decade.

TABLE 2. Civilian Labor Force by Sex, Race and Ethnic Origin

(1988, and moderate-growth projection in 2000)

Group	Level (in thous.)		Percent Distribution		Percent Distribution of Net Additions	Avg. Annual Growth Rate
	1988	2000	1988	2000	1988–2000	1988–2000
Total	121,669	141,134	100.0	100.0	100.0	1.2
Men	66,927	74,324	55.0	52.7	38.0	0.9
Women	54,742	66,810	45.0	47.3	62.0	1.7
Whites	104,756	118,981	86.1	84.3	73.1	1.1
Blacks	13,205	16,465	10.9	11.7	16.7	1.9
Hispanic *	8,980	14,321	7.4	10.1	27.4	3
Asian & Other **	3,708	5,688	3.0	4.0	10.2	3.6

* Persons of Hispanic origin may be white, black, or Asian.

** Asian & Other includes American Indians, Alaskan Natives, Asians, and Pacific Islanders.

Source: Fullerton, Howard N., Jr. New Labor Force Projections, Spanning 1988 to 2000. *Monthly Labor Review*, Nov. 1989, p. 4.

While men still will constitute the majority of workers, women are expected to account for more than three of every five net additions to the work force between 1988 and 2000. Net additions take into account both those entering and those leaving the labor force. During the 1990s, more women than men are projected to enter the labor force and more men than women are projected to leave. [14] More men than women are expected to retire because there are more men than women 55 years of age or older in the labor force, and they typically have better pension rights and benefits. [15]

MORE MINORITY WORKERS

The labor force is projected to be more racially and ethnically diverse in 2000 than it is presently. Due to comparatively rapid population increases, the growth rates among black workers (1.9 percent annually) and Hispanic workers (4.0 percent annually) are projected to be above average (1.2 percent annually). Consequently, black workers might comprise 11.7 percent of the labor force in 2000, up from 10.9 percent in 1988, and Hispanic workers might comprise 10.1 percent of the labor force in 2000, up from 7.4 percent in 1988. (See Table 2.)

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[14] Fullerton, New Labor Force Projections, p. 11.

[15] Kutscher, Ronald E. Outlook 2000: the Major Trends. *Occupational Outlook Quarterly*, Spring 1990, p. 4.

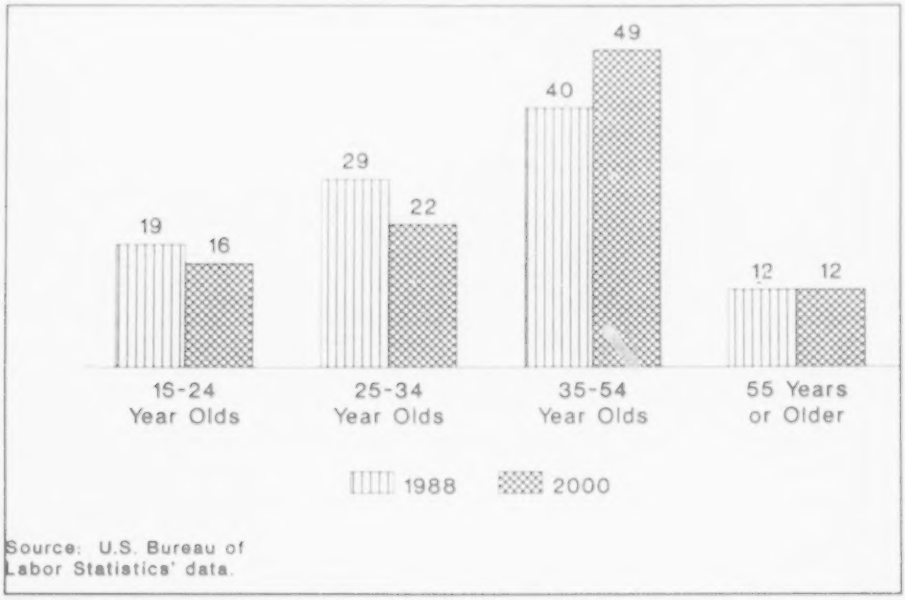
Between 1988 and 2000, black workers could account for 16.7 percent of net additions to the labor force, and Hispanic workers, 27.4 percent. Although the number of white non-Hispanic workers is projected to increase more slowly than the number of minority workers, because of their slower rate of population growth and older age composition, white non-Hispanics will continue to make up the majority of the labor force. [16] In 1988, white non-Hispanic workers were 79 percent of the labor force; in 2000, they are expected to be 74 percent of the total.

In terms of new entrants to the work force, the majority also are projected to continue to be white non-Hispanics (67 percent). [17] More specifically, white non-Hispanic men could comprise about 32 percent of all new entrants; minority group men (i.e., blacks, Hispanics, Asians and other races), 17 percent; and women of all races, nearly 52 percent (about 35 percent white non-Hispanics and 16 percent minorities).

MORE MIDDLE-AGED WORKERS

The labor force is projected to become increasingly middle-aged, that is, between 35 and 54 years old. (See chart 1.) As the baby boomers will be in their thirties, forties, and fifties during the 1990s, middle-aged workers could comprise nearly half of the labor force by the end of the century.

CHART 1. Percent of the Labor Force by Age, 1988 and 2000 (moderate-growth projection)



Source: U.S. Bureau of Labor Statistics' data.

[16] Fullerton, New Labor Force Projections, p. 9-10. BLS developed these approximate proportions of white non-Hispanic workers by excluding Hispanics from the white labor force. According to BLS, more than 95 percent of Hispanics (an ethnic group) are counted as white (a racial group).

[17] Ibid., p. 11.

In 1988, half of all workers were under 36 years of age. By 2000, it is anticipated that the median age of labor force members could reach 39 years. After World War II, workers' median age peaked in 1962 at nearly 41 years and then dropped to about 34 years in 1980, as the baby boomers entered the labor force. Unless many more older workers than usual were to remain on their jobs, it is unlikely that workers' median age will return to its postwar peak during the 1990s. [18]

Although the youth labor force (16–24 year olds) is projected to number almost 80,000 (0.4 percent) fewer workers in 2000 than in 1988, this small decline masks different underlying patterns within its component age groups. The number of teenage workers is projected to shrink between 1988 and 1995, but to grow thereafter, for a net gain by 2000 of 790,000 teenagers (9.8 percent). [19] Similarly, 20–21 year olds are expected first to decrease and then to increase in number during the 1990s, for a net gain of 275,000 workers (5.3 percent). [20] However, the number of 22–24 year olds in the labor force is projected to decline steadily and substantially through 2000, by 1,145,000 (12.3 percent).

Within the prime working-age groups, divergent patterns are anticipated as well. The number of 25–34-year-old workers is projected to plummet by about 3.8 million (10.8 percent). (See Table 3.) Because of the continuing rise in women's labor force participation, most of the decrease likely will occur among men. In contrast, the middle-aged labor force could have a sizeable net gain of some 21 million workers (43.4 percent), with the fastest growing age groups being 45–54 year olds followed by 35–44 year olds. Most of the increase likely will occur among women.

The number of older workers also could expand, by 2.3 million workers (15.4 percent), through 2000. Once again, most of the increase likely will occur among women. Despite this increase in the number of older workers, their share of the aggregate labor force is projected to remain about the same in 2000 as it was in 1988. (See chart 1.)

A Decade of Greater Attention to Human Resources?

During the 1960s and 1970s, firms enjoyed the fruits of the baby-boom generation in a large supply of young workers. Because of the baby boomers' great number, employers typically did not have to be concerned about where they were going to get workers. Because of competition among baby boomers for available jobs, in fact, firms were able to hold down labor costs below what they otherwise might have been. The supply of labor was not only plentiful, but also fairly well educated compared to earlier generations of workers.

As the labor force expanded slowly during the 1980s and will continue to do so during the 1990s, firms will have to compete for new workers from the small baby-bust generation. Tighter labor markets also will likely prompt employers to increase investment in labor-saving technology and to manage their current employees

[18] Ibid.
[19] Ibid., p. 8.
[20] Percent change calculated from unpublished BLS data.

TABLE 3. Civilian Labor Force by Age and Sex

(1988, and moderate-growth projection in 2000)

Group	Level (in thous.)		Absolute Change (in thous.)	Percent Change	Avg. Annual Growth Rate
	1988	2000	1988–2000	1988–2000	1988–2000
Total	121,669	141,134	19,465	16.0	1.2
Men	66,927	74,324	7,397	11.1	0.9
16–19 years old	4,159	4,422	263	6.3	0.5
20–24 years old	7,594	6,930	−664	−8.7	−0.8
25–34 years old	19,742	16,572	−3,170	−16.1	−1.4
35–44 years old	16,074	20,188	4,114	25.6	1.9
45–54 years old	10,566	16,395	5,829	55.2	3.7
55–64 years old	6,831	7,796	965	14.1	1.1
65 years or older	1,960	2,021	61	3.1	0.3
Women	54,742	66,810	12,068	22.0	1.7
16–19 years old	3,872	4,399	527	13.6	1.1
20–24 years old	6,910	6,705	−205	−3.0	−0.3
25–34 years old	15,761	15,105	−656	−4.2	−0.4
35–44 years old	13,361	18,584	5,223	39.1	2.8
45–54 years old	8,537	14,423	5,886	68.9	4.5
55–64 years old	4,977	6,140	1,163	23.4	1.8
65 years or older	1,324	1,454	130	9.8	0.8

Source: Fullerton, Howard N. Jr. New Labor Force Projections, Spanning 1988 to 2000. *Monthly Labor Review*, Nov. 1989. p. 8.

more effectively.[21] "The demographic trends now becoming apparent suggest that in the 1990s U.S. business will have to give more emphasis to human capital investment,"[22] including (re)training for experienced employees; on-the-job or subsidized training for newly-hired high school dropouts and graduates; recruitment, promotion, retention, and (re)training of older workers; and English-language courses for foreign-born workers. While some firms already are responding to scarcer labor and a more diverse work force in these as well as other ways, it appears that many firms have not yet begun to react.

RECRUITING AND RETAINING A DIVERSE WORK FORCE

No longer able to count on a plentiful stream of young workers moving into entry-level jobs, firms could expand their hiring horizons to include groups that they formerly had ignored or avoided. Such groups might include the handicapped and disabled, minorities, retirees, individuals on welfare, persons in drug and alcohol rehabilitation programs, and ex-convicts. Thus, the changing demographics of the labor force could provide new opportunities for segments of the population that typically have had difficulties in the job market.

As a consequence of hiring people from these groups, companies could find that they need to provide more orientation, counseling, and training than they did in the past. Firms might recruit applicants from inner cities, for example, who then would receive train-

[21] Winter, Ralph E. Scarcity of Workers is Kindling Inflation. *Wall Street Journal*, Mar. 28, 1990. p. A2.

[22] Erdevig, Eleanor H. Where Will We Get the Workers? *Chicago Fed Letter*, Jan. 1990, no. 29. p. 3.

ing and subsequently would be hired if they successfully completed the course work. [23]

Companies are likely to become more concerned about retaining workers who might otherwise be lured away by other firms. In light of the increasingly heterogenous composition of the labor force, retention policies might include compensation packages tailored to workers' diverse needs. To appeal to working parents who have young children, companies could offer such benefits as parental leave, direct provision of child care, referral to other organizations for child care information or services, or allowing employees to use pre-tax wages for child care. [24] The current labor contract between AT&T and its unions, for example, provides that funds be spent to find ways to offer community-based child care; Johnson & Johnson is building an on-site day care center; and Dayton-Hudson has allocated money to train home care providers so that its workers are able to hire capable persons to stay with their children. [25] To appeal to middle-aged women and men with elderly parents who may require their help, companies could offer leave or assistance specifically for that reason. Travelers intends to permit employees to use (un)paid leave to care for sick relatives and to offer a referral service and financial assistance for elder care. [26] More generally, firms might offer flexible benefit plans so that workers could select those benefits that best meet their specific needs. The competition among firms to attract and retain employees could put small businesses at a disadvantage, however, as they are less able to afford such fringe benefit options.

In addition to using the compensation package as a retention tool, companies might reexamine how they structure jobs and reconsider some of their personnel policies for the same purpose. They might increase the number of part-time jobs if it were found that such arrangements keep more mothers or older persons as employees. F.W. Dodge hires retirees as permanent part-timers rather than relying upon temporary workers. [27] Teledyne Wisconsin Motor offers older workers extra vacation days and then allows them to take the time off or the cash equivalent, thus allowing older employees to cut back on their work hours if they so chose. Firms also might explore such alternative work arrangements as telecommuting and job-sharing, which give additional flexibility to workers who need or want it. Corporate (and Federal) policies that encourage employees to take early retirement might be reconsidered in order to expand the available supply of labor by extending the working lives of employees. [28]

It has been suggested that employers could make the corporate environment more supportive of their diverse work forces. They might, for example, offer mentoring programs which pair new employees with experienced employees, organize minority and

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[23] Dreyfuss, Joel. Get Ready for the New Work Force. *Fortune*, April 23, 1990. p. 176.
[24] Committee for Economic Development. *An America That Works: The Life-Cycle Approach to a Competent Work Force*. New York, 1990. p. 115–126.
[25] Dreyfuss, Get Ready for the New Work Force, p. 176.
[26] Committee for Economic Development, *An American That Works*, p. 147–151.
[27] Ibid., p. 147–151.
[28] Employee Benefit Research Institute. Trends and Issues in Early Retirement. *Issue Brief*, June 1990. p. 10–11, 14–15.

women's networks to help their members adjust to the firm and communicate their needs to management, and train current workers "to be more tolerant of language and cultural differences, identify and reject any racial and sexual prejudices, and to be more accommodating to the handicapped." [29]

Some believe that the changing demographics could make companies go beyond past efforts in affirmative action, as it would now be in their own self-interest do to so. Rather than being a matter of complying with Federal law or "just something nice to do . . . well-developed strategies to reach out, hire, and sustain workers of different ethnic backgrounds are tools of survival." [30] "With the changing demographics, there's no way companies can impose an Anglo male culture. . . . Managers are going to have to learn more about women, more about minorities." [31] Rather than just bringing more minorities and women into firms, greater efforts might be made to move them up the corporate ladder and shatter the "glass ceiling." [32]

A POTENTIAL SKILLS MISMATCH

Along with concern about the implications of a slowly growing labor force comes apprehension among employers that the qualifications of workers—particularly young, entry-level workers—increasingly will be inadequate to meet the skill requirements of jobs. This could be the case if recruiters more often than in the past tap disadvantaged groups. The labor market might be tighter than indicated by the unemployment rate if more of the jobless than in the past lack the necessary skills to perform jobs.

Jobs requiring fairly high skill levels could account for seven out of every ten new jobs created through the end of the century. One-third of the additional jobs projected by 2000 likely will be in occupations requiring advanced education (i.e., those in which individuals typically have completed at least four years of college). Another 36 percent of new jobs could well be in occupations that require high school degrees or some post-secondary education. [33]

As discussed previously, more than two-fifths of the net additions to the labor force during the 1990s are projected to be black and Hispanic workers. Of the new entrants, more than one-fourth are expected to be from black and Hispanic minority groups. Although the proportions of black and Hispanic workers who have completed high school or college have risen during the 1980s, the two minority groups still account for nearly one-third of the least educated labor force members (i.e., those who have not attended or have dropped out of high school). [34] In addition, students today, more than in the past, are believed to be graduating from high school without really having learned the basics needed to qualify for

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[29] Dreyfuss, Get Ready for the New Work Force, p. 165, 168, 176, 180.
[30] Greller, Martin and David M. Nee. *From Baby Boom to Baby Bust*. Mass., Addison-Wesley Publishing Co., Inc., 1989. p. 5–6.
[31] Dreyfuss, Get Ready for the New Work Force, p. 172.
[32] Ibid., p. 168, 180–181.
[33] U.S. Library of Congress. Congressional Research Service. *Labor Shortages: Reality or Myth?* by Linda LeGrande. Report no. 89-487 E. Wash., Aug. 21, 1989. p. 5–6.
[34] Calculated from unpublished BLS data.

jobs. [35] Thus, an increase in the number of blacks and Hispanics with high school degrees would not necessarily signal to employers that more minority group members are bringing adequate skills to the workplace.

Employers frequently are quoted in articles deploring the basic abilities of job applicants. Managers say that many high school graduates cannot read or that new hires in general cannot communicate, write, or think clearly. Often, they blame the public schools for inadequately preparing youngsters. [36] Some firms have reacted to the situation by making grants to elementary and secondary schools, giving stipends for college tuition to promising high school students, [37] helping schools develop curriculums, offering students part-time jobs or internships, donating equipment, and providing speakers. [38]

> Many businesses will need to replace disinterest, or at best philanthropic participation, in publicly funded employment and training programs and vocational education institutions with focused participation, based on a meaningful public-private partnership designed to enhance the system's capacity to produce well-trained job applicants. Many firms already have imaginative education-enhancement programs, as well as firm-specific training programs, to bring minorities into full participation, but this involvement by business will need to become pervasive before mutual advantage is fully realized. [39]

Companies also are finding that workers already on the payroll who are asked to perform new tasks either never had or no longer have the ability to do them. Consequently, some companies have started their own remediation programs to upgrade workers' skills. [40] Others have linked pay with skills acquisition, such as General Motors and General Electric. [41]

In addition to making these investments in human capital, employers may try to minimize their use of labor. [42] Companies might cut employment by reorganizing jobs, for example, broadening job descriptions so that one person does more tasks. Firms could increasingly rely on labor-saving technology as well as make use of technology to simplify jobs so that available workers are able to perform them. Employers might turn to imported labor, to the extent that they are allowed to under Federal law. They could also send operations abroad and thereby export potential jobs for U.S. workers to other countries.

UTILIZING AN AGING LABOR FORCE

As noted previously, middle-aged workers could account for about half of the labor force in 2000 and will be by far the fastest-

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[35] Evans, Angela. Education for a Productive Labor Force. *CRS Review*, June 1989. p. 8-9; and, Lyke, Robert F. Linking School to Work. *CRS Review*, Oct. 1988. p. 16-17.

[36] Richards, Bill. Wanting Workers. *Wall Street Journal*, Education supplement, Feb. 9, 1990. p. R10-R11.

[37] Dolan, Carrie. The Educator-Executive. *Wall Street Journal*, Education supplement, Feb. 9, 1990. p. R20.

[38] Crossen, Cynthia. Getting Down to Business. *Wall Street Journal*, Education supplement, Feb. 9, 1990. p. R30.

[39] Redwood, Anthony. Human Resources Management in the 1990s. *Business Horizons*, Jan./Feb. 1990. p. 79.

[40] Charlier, Marj. Back to Basics. *Wall Street Journal*, Education supplement, Feb. 9, 1990. p. R14-R15.

[41] Committee for Economic Development, *An America That Works*, p. 97-98.

[42] LeGrande, *Labor Shortages: Reality or Myth?* p. 10-12.

growing group. Firms, no longer able to count on a plentiful stream of young workers, likely will feel compelled to hold onto workers between 35 and 65 and to use them more productively.

In view of corporations' recent efforts to become "lean and mean" by trimming their management structures, the sharpened organizational pyramid may conflict with the aspirations of mid-career baby boomers.[43] There could be fewer high-level, high-paying positions into which to be promoted. There will be many middle-aged workers competing with one another, as well as with younger workers, for these scarce career-advancing opportunities.

The potential oversupply might act to hold down the rate of pay increases among mid-career workers. It also might lower morale and cause discontent. Middle-aged workers could lose their motivation as well if firms' wage structures become more compressed, as higher wages for scarce entry-level workers bump up against mid-career salaries.[44]

A middle-aged work force with limited job satisfaction could adversely affect productivity. So too could erosion of the group's human capital: they have been out of school for many years during which the world of work has undergone significant change.[45] The greater level of productivity that some attribute to mature, experienced workers also could be outweighed by what others perceive as their lower level of adaptability and responsiveness to new ideas and techniques. In addition, middle-aged workers may be less willing to move, change jobs, or retrain/upgrade their skills in order to change occupations.[46]

> Americans' view of the world will be shattered by the impact of the baby boom/baby bust . . . They want to see themselves progressing through careers with increasing responsibility, status, and compensation and with opportunities that their parents had . . . The progress of the baby-boom generation will not be the progress of its parents. Those who remain within large corporations must be prepared to complete their careers in middle-level jobs, some of which were not previously thought of as career-level positions. For some this will be a source of satisfaction; they will be able to develop specialized expertise and apply it over a longer period of time. Others will experience a crushing sense of failure as they look in vain for the career progress that would validate their sense of self-worth.
>
> In the future, either human resources become an integral part of the strategic [business] plan or else they will serve as a constraint. Failure to manage the [human] resources will result in foregone business opportunities.[47]

BUSINESS' REACTIONS TO DATE

It appears that employers have just begun to put more emphasis on maintaining the human resources that their businesses will need, as evidenced by their still evolving strategies designed to deal with the changing demographics of the labor force.[48] Of those firms that have taken actions, many to date are employing fairly conventional methods (e.g., raising wages and enhancing employee benefits). Others are adopting a broader strategic approach by reor-

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[43] Greller and Nee, *From Baby Boom to Baby Bust*, p. 9-10, 20.
[44] Redwood, *Human Resources Management in the 1990s*, p. 78.
[45] Ibid., p. 76-77.
[46] See page 19-20 for elaboration on this point.
[47] Greller and Nee, *From Baby Boom to Baby Bust*, p. 238-239.
[48] Towers Perrin and Hudson Institute. *Workforce 2000, Competing in a Seller's Market: Is Corporate America Prepared?* 1990. p. 19.

ganizing work assignments, increasing their use of technology and automation, and raising capital investment to boost labor productivity.

With women and minorities already present in large numbers at many firms, it is not surprising that effectively managing a diverse work force is of concern to employers.[49] But their concern, in many instances, has not yet been translated into concrete actions. After having actively recruited women and minorities, few companies have systems in place to assist them. The use of support groups and mentor programs is limited, and supervisors do not often receive training in how to manage their disparate subordinates. Neither child care nor leave benefits are common.

Employers' concern and action about labor shortages and skills mismatches have lagged behind their efforts to "manage diversity."[50] They still are relying primarily upon such traditional methods as job fairs and recruiting outside their immediate geographic areas. Many fewer companies have been hiring from groups that they once might have overlooked or providing on-the-job training and remedial education.

The aging of the labor force does not appear to provoke as much concern among employers as either the growing diversity of new workers or their relative scarcity.[51] Given this low level of concern, it is not surprising that very few companies have retraining programs for their aging employees.

Implications for Economic Growth and Living Standards

A slow-growing labor force implies that unemployment will rise more slowly in recessions and come down faster in periods of growth. Tendencies toward lower unemployment and labor scarcity would make wages more buoyant as employers compete to recruit and retain workers. Whether wage increases mean gains in real purchasing power or only contribute to inflation depends on the extent to which productivity gains accelerate to match wage increases.

TIGHT LABOR MARKETS, WAGES, AND INFLATION

The unemployment rate fell from just under 10 percent in 1981 and 1982 to 5.3 percent in 1989. (See Table 4.) This was the lowest level since 1973 when unemployment measured 4.9 percent. The decline in joblessness after the 1981–82 recession was due, in part, to more rapid increases in employment than in the size of the labor force.[52]

Civilian employment increased substantially (4.1 percent) in 1984, while the labor force expanded by just 1.8 percent. Although employment growth dropped by half in 1985 and remained just above 2 percent each year thereafter, it still was greater than the annual increase in the labor force.

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[49] Ibid., p. 2, 10, 12–13.
[50] Ibid., p. 2–3, 14–16.
[51] Ibid., p. 2, 11, 17.
[52] Browne, Lynn E. The Labor Force, Unemployment Rates, and Wage Pressures. *New England Economic Review*, Jan./Feb. 1989. p. 22.

TABLE 4. Labor Force and Employment Growth, and the Unemployment Rate during the 1980s

Year	Unemployment Rate	Percent Change	
		Civilian Labor Force	Civilian Employment
1980	7.1	—	—
1981	7.6	1.6	1.1
1982	9.7	1.4	−0.8
1983	9.6	1.2	1.3
1984	7.5	1.8	4.1
1985	7.2	1.7	2.0
1986	7.0	2.1	2.3
1987	6.2	1.7	2.6
1988	5.5	1.5	2.2
1989	5.3	1.8	2.1

Source: U.S. Bureau of Labor Statistics. *Employment and Earnings*, January 1990, p. 160.

The smaller size of the youth labor force in the 1980s compared to the 1970s contributed to unemployment's decline, as well. Because younger workers are more prone to joblessness than older workers, regardless of the stage of the business cycle, a "mature" labor force should have a lower unemployment rate than one dominated by young workers. [53]

Most of the increase in the working-age population during the 1990s is projected to be among 35–54-year-old baby boomers, who generally have the lowest jobless rates. Their increased presence in the labor force going into the 21st century should continue to exert downward pressure on the aggregate unemployment rate. [54] Disappointment of career aspirations because of overcrowding toward the top of a narrowing promotion pyramid, however, could cause more job shifting and experimentation among this group than among earlier groups of middle-aged workers, perhaps undoing some of this benefit.

In any case, wage increases typically accelerate when a relatively low unemployment rate signals a tight labor market. There is some disagreement, however, over the level of unemployment below which wage and price increases would accelerate. This rate is often called the "full-employment rate of unemployment." Estimates of the full-employment rate range from 4.5 percent to 6 percent. Jobless rates from 1988 to 1990 fell within this range. As the unemployment rate approached 5 percent, in fact, some tendencies toward accelerating wage increases began to appear.

After the full-employment rate is reached, economic growth cannot much exceed labor force growth plus labor productivity growth. Attempts to further increase the gross national product (GNP) would result mainly in accelerating inflation. But labor force growth is projected by the BLS to grow only 1.2 percent per year, down from 2.6 percent annually in the 1970s and 1.6 percent annually in the 1980s. Therefore, greater productivity gains will be

[53] Ibid., p. 24.

[54] Flaim, Paul O. Population Changes, the Baby Boom, and the Unemployment Rate. *Monthly Labor Review*, Aug. 1990.

necessary to produce a rapidly expanding economy without a rising inflation rate.

While some economists think that it is possible for GNP growth to rebound during the 1990s to the 3 percent annual average achieved between 1948 and 1973, other economists think that a growth rate of 2.5 percent or less will be feasible without accelerating inflation.[55] Many experts would agree with Lynn Browne's statement that "Unless productivity can be increased, policymakers will have to adjust downwards their views as to what constitutes a desirable rate of growth for the economy."[56]

PRODUCTIVITY AND ECONOMIC GROWTH

Accelerating productivity gains likely will be difficult to achieve, however, because there is little agreement on why they began to slow down in 1973. Among the explanations that have been offered for the deceleration in productivity growth are:

> the effects of shifts in the industrial composition of the economy, changes in the composition of the work force, an apparent slowdown in the growth of capital-labor ratios, the leveling off of research and development expenditures, the rising price of energy during the 1970s, the diverting of investment to pollution abatement expenditures, the impact of government regulations, the maturation of many industries with little new technology, and even changes in attitudes toward work in our society.[57]

The BLS' moderate-growth economic forecast includes only a modest improvement in labor productivity through the end of this century. As measured by real GNP per employee, productivity is projected to increase 1.0 percent annually between 1988 and 2000, marginally higher than the 0.7 percent rate recorded between 1976 and 1988 (the prior 12-year period). The projection of slightly improving productivity gains is based upon two assumptions, namely, an increase in the share of the labor force in its prime working years and an increase in the growth rate of capital stock per worker.[58]

While it can be argued that a mature work force is more experienced and reliable, which should boost productivity, it also can be argued that such a work force is less flexible (e.g., less willing to move, retrain, or change occupations), which could hamper productivity growth.[59] Geographic and occupational mobility are two ways in which the labor market adjusts to economic change. Despite widening regional economic differences during the past decade, migration rates during the 1980s were similar to rates during the 1970s.[60] The aging of the baby-boom generation, many of whom have developed family and social ties in particular areas, may have held down geographic mobility in the 1980s and might continue to do so in the 1990s. Similarly, as younger workers are

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[55] Wessel, David. The Outlook: Troubling Signs of Slower Growth. *Wall Street Journal*, Sept. 10, 1990. p. A1.

[56] Browne, The Labor Force, Unemployment Rates, and Wage Pressures, p. 28.

[57] Norwood, Janet L. The Labor Force of the Future. *Business Economics*, July 1987. p. 11.

[58] Saunders, Norman C. The Aggregate Structure of the Economy. *Monthly Labor Review*, Nov. 1989. p. 22. Growth of 1 percent per year in GNP per employee implies growth of 1.3–1.4 percent in the more familiar gauge of output per hour worked in the private business sector. Cf. Saunders, p. 24, fn. 9.

[59] Johnston and Packer, *Workforce 2000*, p. 81–84.

[60] *Economic Report of the President*. Wash., U.S. Govt. Print. Off., 1990. p. 161–163.

more prone to change occupations than are older workers, the aging of the baby boomers might slow occupational mobility in future years.

At the younger end of the labor force, scarcity of entry-level personnel could force employers to lower standards and hire individuals whose initial qualifications would have been considered inadequate in years past. The productivity of such workers, taking into account the cost of training and supervising them, may be less than that of past entry-level workers. These considerations indicate the macroeconomic as well as social importance of maintaining the skills and motivation of mid-career workers and of enhancing the human capital embodied in young workers.

The assumption of more rapidly growing capital-to-labor ratios in production is perhaps more firmly based. A scarcity of entry-level workers and rising wages would pose incentives for firms to invest in labor-saving technology. At the same time, reduced needs for capital to accompany rapidly growing employment and production would leave more resources available to increase the capital intensity of production. Efforts to reduce the Federal budget deficit during the 1990s, if successful, likewise should lighten demands on capital markets and could permit an easing of interest rates, all of which would facilitate a tendency toward faster gains in capital per worker.

There is considerable divergence among the BLS' three economic growth scenarios as they concern rates of increase in investment and productivity.[61] In its moderate-growth scenario, the BLS projects that the increasing share of real output accounted for by capital investment through 2000 will be insufficient to produce a return to pre-1973 productivity growth rates. The high-growth scenario, however, includes more rapid rates of capital accumulation and projects productivity gains of 1.4 percent annually—twice the 1976–88 trend. Such productivity gains would increase the rate at which real wages per hour would rise and help to avert resource scarcities and inflation, even though the overall GNP growth rate would be no higher than in the earlier period.

What are the implications of these scenarios for American living standards in future years? One measure of living standards is GNP per capita. In addition to the factors discussed above, changes in GNP per capita depend on changes in the employment-to-population ratio (i.e., the share of the population engaged in production). One reason that GNP per capita grew rapidly, at roughly 2 percent from 1948 to 1989, is that "employment growth dramatically exceeded population growth."[62]

The slow growth of population and employment projected for the 1990s and the 21st century mean that growth in capital stock could become increasingly important to attaining a rising standard of living. But increases in capital stock will not occur unless consumption is held down in favor of greater savings.[63] Although econo-

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[61] Saunders, The Aggregate Structure of the Economy, p. 22–24.

[62] Carlson, Keith M. On Maintaining a Rising U.S. Standard of Living Into the Mid-21st Century. *Federal Reserve Bank of St. Louis Review*, Mar./Apr. 1990, p. 9–11.

[63] Ibid., p. 15.

mists differ about how large the potential improvement to productivity due to increases in the capital stock might be, even those who estimate that its effect will be small still endorse efforts to increase the national saving rate:

> The resulting increase in capital formation [from raising the national saving rate by reducing the Federal budget deficit] would shift upward the future path of GNP growth. In the long run, a higher rate of saving and investment will lead to a permanently higher level of productivity and to a faster increase in the growth rate as the nation moves from the lower to the higher path. And given the slow growth of productivity in the past 15 years, adding even a few tenths of a percent to the growth rate would be a significant improvement. [64]

[64] Baily, Martin Neil and Charles L. Schultze. The Productivity of Capital in a Period of Slower Growth. *Brookings Papers on Economic Activity: Microeconomics, 1990.* p. 371-372.

IV. IMPLICATIONS FOR MANUFACTURING INDUSTRIES

By William A. Cox *

The health of the U.S. manufacturing sector is a focus of great concern for policy makers. Manufacturing was the fulcrum of U.S. military power in World War II and is central to defense production today. American advances in industrial technology in the twentieth century, from mass production techniques to aviation, have been sources of national pride. In recent decades manufacturing has provided middle-class incomes to workers of limited education in America's populous eastern cities.

As shown in Table 1, manufacturing's share of total U.S. employment has been declining since the 1950s. (Particular years are selected for display in the table because each occurred at a comparable—fairly advanced—stage of a business-cycle expansion.) In absolute terms manufacturing's employment peaked in 1979 at 21 million persons. Manufacturing also has accounted for a shrinking share of the value of GNP.

The record is not all negative, however. As Table 1 also shows, manufacturing's share of "real" GNP in constant 1982 dollars—at 22.8 percent—was greater in 1988 than in 1956. Many sectors, including machinery, electrical and electronic equipment, aircraft, instruments and chemicals, have been growing rapidly and taking the place of basic metals industries, motor vehicles, tobacco and leather goods, which have declined. In terms of *real* output, therefore, manufacturing has held its own.

Manufacturing's share of current-dollar GNP has declined because its prices have risen more slowly than those of other sectors. Its prices have risen more slowly in large part because its productivity has grown faster and its profits and even wages have risen by less, especially in the 1980s, than those in other parts of the economy. This results in part from the fact that its production processes are more amenable to automation than others, and in part from the fact that manufacturing is subject to intense global competition, including competition from low-wage countries. It also reflects the soaring productivity of the computer-manufacturing industry, measured in part by the *quality* of its output.

In recent years old-line basic industries, including steel, nonferrous metals, motor vehicles, textiles and leather goods, have been squeezed between slowly growing or shrinking markets on one hand and intensifying world competition on the other. They also were hit hard by the energy price increases and pollution controls imposed in the 1970s. All trade-affected industries—both exporters and import competitors—were severely handicapped by the dollar's

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soaring exchange rate in the mid-1980s, which priced U.S. industries out of markets both at home and abroad. This influence has now been substantially reversed.

TABLE 1. Manufacturing in the U.S. Economy

Year	Mfg	Durable Goods	Nondurables
	Percents of Total Employment		
1956	26.2	14.9	11.3
1966	25.6	15.0	10.6
1978	21.0	12.5	8.5
1988	16.6	9.8	6.8
	Percents of GNP		
1956	29.7	17.3	12.4
1966	28.2	16.9	11.2
1978	23.1	14.1	9.0
1988	19.3	10.8	8.5
	Percents of GNP in 1982 Dollars		
1956	21.7	13.6	8.1
1966	22.5	14.1	8.4
1978	22.3	13.6	8.7
1988	22.8	14.2	8.6

SOURCES: *Economic Report of the President*, February 1991, Appendix B, Statistical Tables B-10, B-11, B-32 and B-43. The figures for 1988 were revised in April 1991; see Michael F. Mohr, Gross National Product by Industry, 1987-89, *Survey of Current Business*, April 1991, p. 25 f.

These developments have brought reductions in the production capacity of the American steel industry of close to 30 percent since 1973 and cuts in its employment by more than half; a decline of similar proportions has occurred in the nonferrous-metals industry; and the struggle continues by the American motor-vehicle manufacturers to maintain their sales and production even with restrictions on exports of Japanese cars to the United States. The radical decline of American machine-tool makers is well known. Even American semi-conductor producers lost a significant part of their world market share to Japanese competitors in the 1980s, and there is much concern about the ability of American firms to hold their own in races to develop and market many leading-edge technologies.

Fears of a generalized loss of industrial competitiveness as other nations' industrial prowess has grown have given rise to controversial proposals to assist U.S. industries through Federal policies of various kinds. Many policy makers fear that further decline of America's basic industries could erode the Nation's technological capability to compete globally for markets (and jobs) as well as its defense production capacity. It is not the purpose of this paper to discuss the cases for and against Government assistance to U.S. manufacturing. Its intention instead is to assess the sector's market prospects in the 1990s in light of slowing population growth and other foreseeable factors.

Substantially slower labor-force growth in the future clearly implies a somewhat lower limit on the Nation's long-term potential for economic growth, although part of the slowdown in labor supply growth may be offset by faster growth in labor productivity. The impact of slower household formation on purchases of building

materials, major household installations and other durable consumer goods means a disproportionate slowdown in demand growth for industries producing such goods. A potentially sizeable cutback in military procurement by the Federal Government would be another negative influence bearing on many of the same industries.

Yet the magnitude of these restraining influences in the context of manufacturing as a whole should not be overstated, and their significance relative to the overall economy—now about four-fifths nonmanufacturing—is fairly small. Potential offsetting influences such as a long-term improvement in the Nation's balance of international trade, renewed growth in infrastructure investment, including electric power generation, and continuing strength in business investment in machinery and equipment could play counterbalancing roles. This section attempts to assess how these factors may add up in the years ahead. In doing so it draws extensively on other parts of this report.

Impact of Slower Growth on Durable-Goods Industries

The concerns raised by demographic trends as well as by cutbacks in military procurement are primarily concerns about industries manufacturing *durable* goods. These include basic metals and metal-fabricating industries and others making products with service lives of three years or more. These industries are the backbone of defense production and are central to concerns about the Nation's industrial health. Thus a concentration of focus on them is appropriate. Durable-goods industries in 1988 produced 56 percent of the value of U.S. manufactured output but only 11 percent of GNP; they provided less than 10 percent of American jobs.

Much of the need for any durable good is satisfied *not* by new production but through use of the existing stock of such goods. There are, for instance, more than 100 million passenger vehicles on American roads, but less than 15 million newly produced ones are sold annually. There are some 70 million dwelling units in the American housing stock, but fewer than 1.5 million are built annually. New production is needed to replace the part of that stock that becomes obsolete or unserviceable, and some may be needed to satisfy *growth* in the demand for current usage.

Current usage depends basically on consumer tastes, the price of the good (relative to others), real income and population; the rate of change in usage depends on changes in these determinants. Changes in real income and population, usually upward, contribute consistently to the expansion of demand.

Demand for new production depends most heavily on the rate of growth in usage in cases of long-lived durable goods for which replacement demand is small compared to current usage. The greater the past growth of usage, furthermore, the smaller the replacement demand as a percentage of today's stock, and the larger the relative role of growth. At the extreme, a hypothetical product that never wears out—the ultimate durable good—needs no replacement, and the demand for current production of it depends *entirely* on growth in demand for its use. When the growth of usage changes, the impact on current production can be dramatic com-

pared to the case of a shorter-lived good for which replacement demand is a larger share.

At the other extreme, goods that are perishable or are completely consumed in use (food and fuel products, for instance) must be fully replaced after each use, unless usage is declining. In some cases business and consumer inventories are replaced from new production several times each year. In this case the demand for current production to accommodate *growth* in consumption because of population increase or other factors will be much smaller relative to the total demand for new production. And changes in that growth rate, while significant, would be much less critical to producers. The different roles of stock replacement and growth of usage in accounting for the demand for long-lived and short-lived products helps to explain why the impact of a demographic slowdown or any other factor affecting growth would be greater for long-lived (durable) goods.

The longer the service life of a product between these two extremes, the smaller the replacement demand will be relative to the existing stock at any time, and the larger the role of growth in usage in explaining demand for current production. However, growth in current usage becomes a dominant factor in the demand for new production relative to stock replacement only for *very* long-lived capital.

Housing with a service life of, say, 60 years, is one of the longest-lived products. If the housing stock has grown at two percent per year, as it has in the United States during most of the 20th century, the annual need for replacement will be about 0.9 percent of the stock.[1] If two-percent growth continues, demand for current production will be the sum of these components (2 + 0.9 percent), or 2.9 percent of the stock. If household formation accelerates to 2.4 percent, as it did in the 1970s when the baby boomers were forming households, then the total need for new homebuilding rises in this example to 3.3 percent of the existing stock, of which the component to accommodate growth would account for nearly three-quarters. With such heavy demand for new building, some is likely to go unsatisfied as rising prices ration available supplies. This, of course, is what happened in the 1970s.

If the net rate of household formation then falls to 1.5 percent annually, as it did in the 1980s when the number of young adults began declining, replacement demand is unaffected (because structures being replaced were built 60 years ago), but the currently accruing need for new homebuilding falls by more than one-quarter from 3.3 to 2.4 percent of the current stock. Meanwhile the stock itself has grown, so the decline in absolute terms is smaller. A major slowdown in homebuilding occurred in the 1980s, although some demand unmet in the 1970s helped to sustain activity during that decade.

Net household formation is projected by the Census Bureau to slow even further in the 1990s. The decline over two decades in the

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[1] See Appendix B to this section (pp. 90-91) for the derivation of this number. In the case of housing, some replacement takes the form of rehabilitation of old structures instead of wholly new replacements, so actual demolitions and abandonments of old houses are less than 0.9 percent of the stock.

rate of household formation would bring a 36-percent decline in the amount of new homebuilding needed relative to the current housing stock, according to this model, although the absolute decline would be somewhat smaller. In fact, Barbara Miles, writing in the next section of this report (see pp. 97–98), projects construction of about 30 percent fewer units in the 1990s than in the 1970s. Thus the demand for homebuilding is very sensitive to the expansion component—the rate of household formation. [2]

In the case of major household equipment like water heaters, air conditioners and kitchen appliances with lives of, say, 10 years, about 9 percent of the outstanding stock must be replaced every year in contrast to 0.9 percent for housing with 60-year lives. [3] An expansion in usage of two percent per year in tandem with the increase in housing would mean a total demand for new production of 11 percent of the existing stock of equipment, of which less than one-fifth would be attributable to growth and more than four-fifths to replacement. Thus growth plays a much smaller role.

Even with a slowdown of the expansion in usage for demographic reasons, the absolute demand for new production would continue to increase, albeit more slowly than before, because needs for replacement grow due to past increases in the stock. Thus the demand for new production is much less sensitive to the rate of usage expansion for a product with a ten-year life than for one with a 60-year life. Factors other than demographic change also can play significant roles. Increases in real disposable income per capita boost purchases, as does the declining trend in prices of durable goods relative to other products.

Much of the rest of this chapter of the report reviews the current outlook for major categories of durable-goods purchases: building components, consumer durable goods, business equipment investment, government purchases (mainly for the military), and exports. Table 2 (on p. 76) shows sales of these categories of durable goods in 1976 and 1988 together with projections for the year 2000. This assessment is done with the assistance, where applicable, of projections made by the Bureau of Labor Statistics (BLS). [4] Compound annual growth rates for the intervening twelve-year periods also are shown.

Projections for the year 2000 were made for GNP and for consumers' and producers' purchases of durable goods by the Bureau of Labor Statistics (BLS) using a long-term macroeconomic model. For other categories of purchases the BLS forecast did not distinguish durable goods from other goods and services. For other purchases of durable goods—such as exports, imports, government purchases and building components—assumptions were made by the author in order to illustrate the dynamics of durable-goods markets

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[2] Miles adds that the average new home will be bigger and more luxurious, offsetting some of the drop in starts. It should be noted also that regular repair and maintenance of the building stock (about one-third of total construction activity) is not included in these calculations and could help to smooth out abrupt changes in the demand for new construction.

[3] See Appendix B.

[4] Norman C. Saunders, The aggregate structure of the economy, *Monthly Labor Review*, November 1989, p. 13–24. The *Monthly Labor Review* is published by the Bureau of Labor Statistics, U.S. Department of Labor.

in the United States. These projections are explained in this and subsequent sections of this volume. [5]

Finally the outlook for nondurable goods will be considered, and an integrated picture of prospects for U.S. manufacturing in the 1990s will be drawn into focus.

Implications of Projected Construction Activity

The construction industry is a major user of durable manufactured goods for structural support, utility connections, heating and cooling, sheathing, and many other purposes. About 30 percent of the steel consumed by American industry goes into construction. Construction also absorbs as much as 40 percent of U.S. usage of copper, mainly in electrical wiring, and about 12 percent of the aluminum. [6]

Viewed in historical perspective, real construction activity peaked in 1966 and has fluctuated below that level for the past 25 years. Its share of the economy meanwhile declined by half from 8.8 percent of real GNP in 1966 to 4.3 percent in 1989 (the last year for which production data by industry are available). [7]

Careful studies of the outlook for construction (see Sections V through VIII of this report below) conclude that the demand for upgraded housing by the baby-boom generation plus catch-up industrial and infrastructure investment may sustain a moderate recovery of construction activity from today's recession by the mid-1990s despite little or no prospect of growth over the long term. Even if this outlook is overly optimistic, construction is not expected to decline further, despite the slowdown of population growth, until after the turn of the century.

It is estimated in Section V below that declining net household formation will mean fewer newly constructed housing units over the long-term future than in the past. Declining numbers of young households in particular imply little construction of rental apartments and "starter houses" and lower demand for manufactured housing (prefabs and "mobile homes"). The section also concludes, however, that new units in the future are likely to be larger and more luxurious on average, as new housing needs move upscale with the aging of the baby-boom generation. Some of the rise in quality will be in space per person, and some in the quality of components and workmanship. The value of housing construction, therefore, may not decline even though the number of new units is unlikely to regain earlier peak levels. A question remains about whether the baby boomers on average will succeed in raising their incomes as much in middle-age as previous generations, and whether they will garner sufficient capital gains on their first purchases to amass enough capital to move up.

It is projected in Section VI that office and commercial construction will plummet in the early 1990s and then grow more slowly

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[5] The GNP projection for 2000 may not be strictly compatible with the components estimated by the author. It is nonetheless useful for illustrative purposes.

[6] American Iron and Steel Institute. *Annual Statistical Report*, 1990. U.S. Department of Commerce, *1991 U.S. Industrial Outlook*, Washington, Govt. Print. Off., January 1991, chapter 15.

[7] Construction employment nevertheless grew from 3.3 million in 1966 to 5.1 million in 1988, as productivity in the industry persistently declined. Prices of construction activity have risen substantially faster than those of other products, unlike the prices of its manufactured inputs.

than in the past due to slower labor-force and economic growth. It also was discovered, however, that total private nonresidential construction may be sustained for several years by renewed expansion of the capital-intensive electric utilities after ten years of overcapacity and by an upturn of investment in manufacturing and agriculture as the Nation's trade balance improves. These expansive factors, while sizeable, have substantial components of catch-up investment that will be one-time boosts of limited duration.

Builders of public infrastructure like roads and waste-water facilities also could escape a long-term downturn for a decade or more, despite slower growth in demand for such facilities, if public funding is provided to remedy existing deficiencies and address growing rehabilitation needs in these areas. This funding, of course, is not assured in light of the implications of slower economic growth for government revenues. These possible elements of strength, like those mentioned above, are likely to provide only a temporary respite before the full force of the demographic slowdown is felt.

The outlook for construction as a whole, therefore, is for a weak recovery from the recession of 1990–91 and a shift in the composition of building in the 1990s but no persistent decline until after the turn of the century. The shift in nonresidential construction from commercial projects toward industrial and infrastructure building will require more heavy steel and nonferrous metal components, such as pipeline, tanks and electrical transmission lines, and fewer commodity steel components like reinforcing bars and beams.

If construction activity continues near the rate of the 1980s, then the backlog of deficiencies in public and private structures should be reduced as the accumulation of newly accruing needs slows. Alternatively, if construction remains below the level of the 1980s, then backlogged deficiencies would take correspondingly longer to eliminate, and the long-term decline that is likely to result eventually from the demographic slowdown would be deferred.

Rough estimates of the value of durable inputs into construction are derived by referring to the input-output accounts of the United States for 1986, the latest year for which these accounts have been published.[8] The accounts indicate that nearly one-third (32 percent) of total construction activity in 1986 was repair and maintenance construction, and just over two-thirds were new construction. They indicate furthermore that 22.5 percent of the total amount paid for construction went for building materials and components purchased from durable-goods manufacturing industries, excluding builders' machinery and equipment, which will be encompassed in estimates of business equipment investment cited below (pp. 78–79). About half were metal products, and the remainder was divided equally between wood products and stone, clay and glass components.

These factors are used to estimate the value of such building components from the inflation-adjusted value of new construction in 1976 and 1988. The results are entered in Table 2. These pur-

[8] Annual Input-Output Accounts of the U.S. Economy, 1986, *Survey of Current Business*, v. 71 (February 1991), p. 35 f.

chases grew during this period at a rate of 1.7 percent compounded annually. This rate exceeds their trend rate of growth over this period, however, because construction was depressed in 1976 as the Nation emerged from a deep recession, but 1988 was a good year at least for nonresidential building. The long-term trend rate of growth was less than one percent annually. [9]

TABLE 2. Sales of Durable Goods in the United States

1976, 1988 and Projections for 2000

Category	Billions of 1982 Dollars			Compound Growth Rate (Percent)	
	1976	1988	2000 (Projected)	1976–1988	1988–2000
Building Components	98.0	120.7	134.5	1.7	0.9
Durables Consumption [a,b]	324.6	574.5	753.1	4.8	2.3
Motor Vehicles and Parts	109.6	182.1	220.6	4.1	1.8
Other Durable Goods [b]	215.0	392.4	532.5	5.2	2.5
Producers' Durables [a]	186.2	364.8	530.1	5.6	3.2
Government Purchases	45.1	113.6	105.6	7.7	−0.6
Defense Durables	30.6	83.8	62.9	8.4	−2.4
Federal Nondefense	1.6	5.3	7.6	10.0	3.0
State & Local Governments	12.9	24.5	35.1	5.3	3.0
Balance of Trade	24.4	−46.2	0.0	N.A.	N.A.
Durables Exports	112.9	236.1	500.0	6.1	6.3
Durables Imports	88.5	282.3	500.0	9.7	4.8

[a] These projections for the year 2000 are obtained from BLS (see source below). Other projections are made by the author and elucidated in the text.

[b] Definitions of these categories are those used by Data Resources, Incorporated (DRI) in its macroeconomic model and by BLS. These definitions differ somewhat within the personal consumption category from those of the National Income and Product Accounts.

N.A. — Not Applicable.

SOURCES: Norman C. Saunders, The aggregate structure of the economy, *Monthly Labor Review* (Bureau of Labor Statistics), November 1989, p. 13–24. Also the U.S. National Income and Product Accounts and author's estimates.

In estimating the value of durable goods that may be utilized in construction in the year 2000, total construction activity is projected to continue growing at a rate of 0.9 percent compounded annually. It is assumed that the fraction of construction's total value going for durable materials and components will remain the same as in 1986. The resulting estimate for the year 2000, entered in Table 2, implies that such components will constitute a shrinking share of total purchases of durable goods over this decade. [10]

Implications for Consumer Durable Goods

Fewer new housing starts should mean slower growth in sales of major household equipment ranging from furnaces, water heaters, stoves, washer-dryers and air-conditioners to furniture, carpeting and materials that go into these items. Slow growth of adult population, especially of young adults, also means slow growth in sales of automobiles, light trucks and recreational vehicles and of compo-

[9] The rate from 1978 to 1988, more nearly comparable years, was only 0.9 percent compounded annually.

[10] These growth projections are lower than those by the Bureau of Labor Statistics for the growth of *private* construction only. First among the reasons for this difference is the fact that BLS' numbers did not include Government construction, which has grown much more slowly than construction for private purchasers. Second, revisions to recent data on private construction have lowered growth rates somewhat for the historical period, 1976 to 1988. These differences, combined with the fact that growth rates for that period exceeded the trend for the period because of a depressed level of activity in the base year, make BLS' growth projections for 1988 to 2000 seem substantially too high.

nents and materials that go into their production. Tightening of motor-vehicle fuel-economy standards could reduce the size and metal content of vehicles, not to mention the demand for gasoline, as the initial fuel-economy standards did when imposed more than a decade ago.

Automotive uses plus household equipment and appliances account for nearly 30 percent of U.S. steel consumption, 20 percent of aluminum usage and nearly 20 percent of the copper. These uses, when combined with construction, account for about 60 percent of U.S. steel and copper consumption and one-third of the aluminum.

How much of a slowdown is likely? Growth in the use of these durable goods would decline as the rate of household formation slows. As outlined above (p. 73), however, replacement of the existing stock is a major part (circa 80 percent) of the demand for new production. In absolute terms, therefore, demand is expected to continue growing slowly. Increases meanwhile in real income per capita could boost purchases, and declines in the relative (quality-adjusted) prices of durable goods also would work in this direction.

The Bureau of Labor Statistics (BLS), using a computer model that takes these factors into account, has projected the growth and composition of GNP through the end of the century. In addition to slower GNP growth than in the past, it projects an even greater slowdown in disposable personal income growth because of a projected rise in personal taxes and an increase in the share of income going to corporate profits.[11] Consumer spending also is constrained by a small projected rise in the personal saving rate.

The BLS offered the following analysis of the outlook for automobiles:

> The U.S. automotive market has reached a plateau: virtually all of the macroeconomic determinants of car sales—the labor force, the number of households, and the driving-age population—are expected to grow far more slowly in the coming decade than during the past 12 years, resulting in a slower rate of growth in automobile sales. The cost of car ownership is also expected to rise with increasing gas prices throughout the projection period.
>
> Industry trends, as well, support a slow-growth sales outlook. Loan maturities are increasing—from around 4 years in 1984 to almost 5 presently—leaving many buyers with a debt burden greater than the value of the car for a longer period of time. In such positions of "negative equity," buyers are inclined to wait a bit longer before trading the vehicle for a new one; longer trade-in cycles and a lower scrappage rate are a direct result. This tendency is reinforced by the manufacturer's policy of offering extended warranties, . . .
>
> Parts sales are expected to be relatively higher over the coming decade as cars are held longer. Taken together, *motor vehicles and parts sales, in real terms, are expected to grow at a very moderate pace of 1.8 percent each year between 1988 and 2000, down from the much higher real sales pace of 4.1 percent annually between 1976 and 1988* (italics added).[12]

This slower projected rate of growth is entered in Table 2 (p. 76) for consumer purchases of motor vehicles. Much of the earlier period's growth, of course, was served by imported motor vehicles instead of U.S. production. Imports rose from 13 percent of the number of vehicles sold at retail in 1976 to 24 percent in 1988,[13]

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[11] Norman C. Saunders, The aggregate structure of the economy, p. 17, 22.

[12] Ibid., p. 18.

[13] *MVMA Motor Vehicle Facts and Figures '90*. Motor Vehicle Manufacturers' Association, Detroit Michigan, 1990, p. 7

and the import share in value terms rose by even more. Both the trend toward more production of Japanese-designed cars in the United States and improvements in American-designed models, as well as the lower exchange rate of the dollar, suggest that the import share may increase less rapidly in the future and could even decline.

The BLS projected also that growth in spending on other durable consumer goods, which proceeded at the rapid rate of 5.2 percent annually from 1976 through 1988, also would slow "dramatically" to half of that rate over the ensuing 12 years to 2000. The earlier period's fast growth was due to rapid household formation by the baby boomers and to their enthusiasm for consumer electronics, together with rapid technical advances and price reductions in electronic products. These contrasting growth rates also are entered in the appropriate places in Table 2 above.

Growth in consumers' spending for electronic audio and video equipment may not slow as much as that for nonelectronic appliances and furnishings because of the high income elasticity of demand for electronics and the prospect that swelling ranks of middle-aged baby boomers will continue to diversify and upgrade their electronic equipment. [14] This is made more likely by the prospect of steady technical and design improvements and the frequent introduction of innovative new products in this field, unlike more traditional home furnishings. Electronic products also are characterized by persistent price reductions.

Ironically these high-tech products may be extensively imported because some of them, unlike automobiles, are not manufactured in the United States but are available only from abroad. The fast-growing demand for them, therefore, may not benefit American producers much. Innovations during the 1990s will include digital audio systems and possibly high-definition television. [15] For this reason the overall slackening in demand growth for consumer durable goods probably will not benefit America's balance of trade as much as otherwise might be expected, and the slowdown in demand implied for other durable consumer goods is likely to be even greater than implied by growth projections including electronics.

Business Investment in Capital Equipment

The second largest end-use category of durable goods after consumer durables is business investment in machinery, equipment and motor vehicles. Purchases in this category, excluding inflation, grew at a compound annual rate of 5.6 percent from 1976 through 1988, although this growth rate, like that of other durable goods, is considerably higher than the long-term trend because business investment in 1976 was quite depressed in the aftermath of a deep recession. From 1978 to 1988 (more similar years) it grew at the still healthy rate of 4.1 percent annually, while GNP rose at 2.5 percent.

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[14] Saunders, *op. cit.* p. 18.

[15] Digital audio systems, which already are being marketed abroad and soon will reach the United States, will be exclusively imported. The race to market high-definition TV systems includes strong American competitors, and the outcome remains to be seen.

An important reason for the rapid growth of investment in producers' durable goods is the computer revolution that has swept the land in recent years. Countless tasks that had been handled manually—from brokerage firms' "back offices" to retailers' warehouses—have now been automated by computers. In the 1980s office workers from secretaries to managers were equipped with personal computers. Excluding office equipment, business equipment investment has grown no faster than GNP as a whole. Businesses also made large investments in motor vehicles during this period.

Most projections foresee slower growth in business equipment investment in the future, partly because the initial wave of investment in personal computers and work stations may subside into a more normal replacement and expansion mode. The BLS projects that equipment investment will grow by only 3.2 percent annually, excluding inflation, from 1988 to 2000. This projection is entered for business equipment investment in Table 2. Although it represents a disproportionate slowdown relative to the slowdown foreseen for GNP growth, which is projected to fall from 2.9 to 2.2 percent per year, producers' investment in durable equipment still would rise gradually as a share of GNP.

Impact of a Slowdown in Military Procurement

Slower growth of private demand for durable goods in the 1990s is expected to come together with long-term cutbacks in military procurement made possible by the decline in the military threat posed by the Soviet Union. Guidance to the armed services from the Chairman of the Joint Chiefs of Staff is to plan for a 25-percent reduction in the real purchasing power of the military budget over five years. The extent to which this prospective cut will be restrained by changing circumstances in the Soviet Union or by events elsewhere remains to be seen.

More than 75 percent of the durable-goods purchases by all levels of government in 1988 were by the Federal Government, and nearly all of these were for the military forces. Significant purchases also were made by State and local governments. As indicated in Table 2, Federal defense purchases grew by 8.4 percent per year, excluding inflation, from $30.6 billion in 1976 to $83.8 billion in 1988, while State and local purchases grew at 5.3 percent. Federal purchases of durable goods for purposes other than the military were quite small.

The importance to the economy of durable-goods purchases for the military, however, is often exaggerated. To assess the significance of these purchases, it is informative to place them into the broader context of total defense spending, total durable-goods manufacturing, and GNP. Total outlays for national defense in 1988 came to $297 billion or about 5.7 percent of GNP. Barely more than one-quarter of this amount—1.6 percent of GNP—went for durable goods, mainly aircraft, missiles, ships, vehicles and electronic equipment. The balance went for compensation of Defense Department personnel, for contract services, including research and development, and for nondurable goods like fuel.

Total U.S. production of durable goods in 1988 was about 11 percent of GNP. The value of durable goods purchased by the Government, however, includes delivery charges and other nonmanufacturing costs, and a small fraction of these goods is purchased abroad. Purchases for the military in 1988, therefore, came to less than 15 percent of the output of durable-goods industries. [16] Durable-goods purchases by all levels of government in 1988, even after the military build-up of the 1980s, were smaller than any other category of purchases shown in Table 2. Exports of durable goods were more than twice as large. On the other hand, due to the nature of competition in weaponry development, some production for the military is always advancing the frontiers of science and technology and hence has a potential significance not captured by its relative dollar value.

A cut of one-quarter in durable-goods purchases for national defense from the 1988 level would be about $21 billion (in 1982 dollars), less than 4 percent of total U.S. durables output. Such cuts would take effect over several years ending in fiscal year 1997. Other cuts would be made in the other parts of the defense budget. By the year 2000, of course, these reductions could become larger or, depending on developments, could be reversed.

For the purpose of this analysis we assume that the projected cutback will be carried out and that inflation-adjusted spending will remain at the lower FY97 level through 2000. As indicated in Table 2 above, this implies a reduction in defense purchases averaging 2.4 percent per year from 1988 through 2000. Even after such a cutback, defense procurement of durable goods would remain about twice as large in real terms as in 1976 before the start of the Carter-Reagan military buildup.

Military production plays a decisive role in a few narrow industries, particularly aircraft, missiles and shipbuilding. Defense purchases accounted for 50 to 70 percent of the gross output of these sectors even in recent years of peacetime. By contrast, defense orders accounted for only 5 to 10 percent of output in other broader industrial sectors such as electrical equipment and components, instruments, primary metals, and mining. [17] Thus potential cutbacks in military procurement will have heavy impacts on certain firms and communities producing aircraft, missiles, ships, ordnance and electronics for the Department of Defense with much smaller effects on other industries and the economy at large.

As for other durable-goods purchases by Government, both Federal nondefense purchases and those by States and local governments have grown quite rapidly in the past. The 1990 deficit-reduction accord between Congress and President Bush prohibits any transfer of resources freed by planned defense spending cuts to these civilian purposes through fiscal year 1993 but permits them thereafter. Tax revenues at all levels of government, moreover, will grow more slowly in the projection period than in the past if the

[16] If the total output of durable goods constituted 11 percent of GNP, and defense purchases of durables made up 1.6 percent, including some components not produced by the U.S. manufacturing sector, then defense purchases took less than 15 percent of total value added by this sector.

[17] Annual Input-Output Accounts of the U.S. Economy, 1986, p. 43, Table 1, column 96. Also U.S. Congress. Congressional Budget Office. *Defense Spending and the Economy*. February 1983, p. 13, Table 4.

forecast of slower GNP growth proves to be accurate. For this analysis the assumption is made that these purchases will grow at 3 percent annually from 1988 through 2000. In doing so they would offset about three-fifths of the defense cutback, although they probably would not relieve the distress of specific firms affected by the defense cuts.

Durable Goods in International Trade

The last major category of final purchases is goods for export. The United States in 1988 exported more than $235 billion worth of durable goods (in 1982 dollars), 5.9 percent of GNP. Some major industries—aircraft, computers, industrial and construction machinery, electrical products and instruments—regularly export sizeable shares of their production. Such exports have grown rapidly in recent years, although imports of durable goods concentrated in the same broad product categories have grown even faster (see Table 2). Because figures cited above for sales of durable goods within the United States include significant amounts of imports, these must be netted out in any attempt to assess the growth in purchases of *U.S.-produced* durable goods.

The dollar's exchange rate, although fluctuating substantially, has pursued a generally downward trend since 1985 and, after adjustment for inflation, is now about 30 percent below that year's peak relative to the currencies of 16 important countries on a trade-weighted basis.[18] The U.S. trade deficit has declined in real terms by more than 70 percent from 1986's record level to 1990 (cf. "net exports" in constant 1982 dollars in the National Income and Product Accounts). In current dollars, however, taking account of big increases in prices of imports due in part to exchange-rate changes, the trade deficit began declining only late in 1987 and remains just under $100 billion today. Capital movements into the United States by investors of all kinds finance this gap.

If global investors continue purchasing dollars to acquire U.S. assets at this rate, the current-account deficit can continue at this level. If investors do not continue these purchases, the dollar's exchange rate would decline further, making U.S. exports cheaper abroad and imports more expensive, helping to reduce the deficit, especially in real terms. It is the balance of trade in real terms that determines trade's impact on U.S. producers. While a lower exchange rate reduces the welfare of Americans as consumers by raising prices of foreign products, it permits U.S. producers to recapture markets from foreign suppliers and/or to raise prices themselves with less concern about foreign competition.

The trade balance also could improve through changes in the balance of savings and investment among countries. This could happen, for instance, if the Federal Government reduces its budget deficit (dissaving), curbing import demand in this country, and/or if heavy investment in eastern Germany and possibly in other countries of eastern Europe or in the Soviet Union draws American exports into these areas or into other markets no longer ade-

[18] In addition to the Japanese yen, the Canadian dollar and currencies of the major countries of western Europe, this index includes the currencies of Mexico, South Korea, Taiwan, and certain other newly industrializing countries.

quately supplied from western Germany and other parts of Europe. Even Japan, through changes in policy as well as through demographic developments, may be shifting toward less saving and more domestic investment, which would reduce its export surplus. The Persian Gulf oil-producing countries, furthermore, will be making large expenditures on U.S. exports in the aftermath of the 1991 war. Most analysts believe that, after nine years of mega-deficits in the U.S. current account with at least a few more to come, and with a corresponding decline in our balance of investment income, the U.S. trade balance will have to improve by one means or another.

For these reasons, continuing rapid growth of durable-goods exports is projected for the period, 1988 to 2000, but slower growth of imports than from 1976 to 1988. These assumptions are entered in Table 2. U.S. exports have grown even faster than assumed there since the turn-around in U.S. trade began in 1986. Exports in real terms grew by 11.5 percent compounded annually from 1986 to 1990, while imports grew by 5.9 percent. [19]

The assumed growth rates through 2000 are chosen fairly arbitrarily. The result of these assumptions is balanced trade in durable goods in the year 2000. The level of durables exports is projected to rise from 6 to 9½ percent of GNP between 1988 and 2000, while imports rise from 7 to 9½ percent. One should bear in mind, of course, that this balance is gauged in constant 1982 dollars (i.e., in 1982 prices) and does not necessarily imply balance in the prices of the year 2000. If the assumed trade adjustment takes place in large part through declines in the dollar's exchange value, import prices would be much higher, implying lower terms of trade and yielding a lower current-dollar balance. It also should be noted that these assumptions encompass durable goods only and not the current account as a whole. The sensitivity of our results to this assumption is examined below.

Demography and Nondurables Manufacturing

Production of nondurable goods, defined as those consumed in use either immediately or within three years, constituted 44 percent of the current value of U.S. manufactured output in 1988. Food, fuel, chemicals and clothing are in this category. Demographic changes do not have the same potential to cause dramatic changes in the demand for nondurable goods as for durables. In fact production of nondurables is subject in general to much less fluctuation than that of durables.

This is mainly because inventory replacement dominates the demand for new production, and fluctuations in the growth of usage play much smaller roles in determining this demand than with long-lived goods for which replacement of preexisting stock is a smaller factor. Moreover, users' needs for nondurable goods cannot be satisfied over extended periods by using an existing stock; in most cases purchases of new supplies cannot be deferred by repairing and extending the lives of items already in existence. Finally, nondurable goods are not normally made to order, as often

[19] National income and product accounts.

is the case with durables, but more often are made for and supplied to buyers from inventories, which serve as temporary buffers between changes in customer demand and changes in production.

The production of nondurable manufactures, therefore, typically grows much more smoothly than that of longer-lived goods and more closely in step with the economy at large. Because the economy is expected for demographic reasons to grow more slowly, demand for nondurables production also can be expected to grow more slowly, but it should not experience *disproportionate* slowdowns or outright declines like those foreseen for some types of durable goods. Therefore the analysis devoted to them here is less detailed.

Purchases of one major category of nondurable goods—energy products—were suppressed in real terms in the 1970s and early 1980s by the after-effects of the energy supply disruptions and price increases of the 1970s. Due to mandated increases in efficiency of new motor vehicles, better insulated homes, and generally greater consciousness of energy costs, consumer purchases of energy products, excluding price changes, increased by only 0.7 percent per year from 1976 to 1988. Inflation-adjusted consumer purchases of other nondurable goods—food, pharmaceuticals, toiletries, clothing and so forth—grew by only 1.8 percent annually.

U.S. production of nondurable manufactures grew over this period at a faster rate of 3 percent, practically the same rate as GNP. For the period, 1978 to 1988, which was less influenced by business-cycle variations, GNP grew at a 2.5-percent rate, while nondurables manufacturing grew at 2.4 percent. The growth rate of consumer purchases of nondurables is smaller than that of U.S. production because of continuing economies in distribution (for instance, from department stores to discount houses and mail-order catalogues and from "service stations" to "gas and go" outlets); and because imports of petroleum, which are part of consumption but not of domestic production, went down substantially during this period. Many nondurable goods are absorbed, moreover, as inputs in the industrial sector and not reported explicitly as parts of final demand.

Consumer spending on nondurable goods, excluding inflation, is projected by BLS to grow at the same pace from 1988 to 2000 as in the previous 12 years. Growth of U.S. manufacturing of nondurable goods is projected by the author to slow with the growth of GNP to 2.2 percent per year over the same period. This projection is entered in Table 3 below. Nondurables production would continue to decline gradually as a share of total manufacturing output.

A Summary of Demand and Production by Broad Categories

Table 2 summarized data and projections for durable-goods purchases by major categories. Table 3 aggregates these categories and compares them to data on durable-goods *production* in the United States. It also includes information on production of nondurable goods and total manufacturing output. To allow readers to assess the role of manufacturing in the national economy, the table shows real GNP, historical and projected. The entries in these tables are not strictly comparable with each other, however, and require careful interpretation.

TABLE 3. Production & Sales of U.S.-Made Durable Goods

1976 to 1988 and 1988 to 2000

Category	Billions of 1982 Dollars			Compound Growth Rate	
	1976	1988	2000 (Projected)	1976–1988	1988–2000
GNP	2,826.7	4,016.9	5,222.4	2.9	2.2
Sales of US-Made Durables	586.0	971.1	1,326.7	4.2	2.6
Mfg Gross Product	660.6	917.4	1,231.2	3.5	2.5
Durable Goods	357.4	570.8	779.8	3.9	2.6
Nondurable Goods	243.2	346.7	451.4	3.0	2.2

SOURCES: Entries for 1976 and 1988 are based on the National Income and Product Accounts. Sales of U.S.-made durable goods are derived from Table 2 by summing the major categories of final demand (including exports) and deducting imports. However the Commerce Department's definition of durable consumer goods is used to maintain comparability with the data on durable-goods production. Projections of manufacturing gross product in 2000 are derived by assuming that U.S. durable-goods production will grow at the same rate as sales of U.S.-made durables, and that nondurable goods will grow at the same rate as GNP.

Table 2 showed the amounts spent on durable manufactured goods by final users, converted to constant 1982 dollars. These amounts included not only the costs of manufacturing the goods but also costs of raw materials and other nonmanufactured inputs, plus costs of distribution. Especially in the case of consumer goods, distribution costs can be sizeable. Together with raw-materials costs, they approach half of consumer spending.[20] For other categories this share is much smaller; building components are valued at producer prices. Figures for the various categories of spending also encompass the value of imports included in sales, whether as finished products or as inputs for further processing. Imports of durable goods therefore are deducted in arriving at "sales of U.S.-made durables" in Table 3.

The gross product of durable-goods manufacturing industries shown in Table 3 includes only the value added by those industries excluding the costs of inputs purchased from outside that sector. This manufacturing cost is considerably smaller than the expenditures on these goods by the purchasers. We assume, however, that the *growth rates* of these two aggregates over time bear a close relationship to each other.

Differences between these growth rates could arise through changes in the composition of either of these aggregates, changes in the average mark-up over manufacturing cost, or changes in the amount of inventories held in the distribution chain. The rapid growth of consumer purchases with their large component of distribution cost, plus the slow growth of inventories relative to sales from 1976 to 1988, would tend to make growth in sales exceed growth in production. In fact, as Table 3 shows, constant-dollar purchases of U.S. durables grew during this period at an estimated rate of 4.2 percent annually, while production of them grew at 3.9 percent.

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[20] This fraction is the share of raw materials plus transportation, warehousing, and wholesale and retail trade in total personal consumption expenditures on goods. See Annual Input-Output Accounts of the U.S. Economy, 1986, *Survey of Current Business*, v. 71 (Feb. 1991), p. 43, Table 1, column 91.

Entries in Table 3 indicate that sales of U.S.-made durable goods rose from 20.7 percent of GNP in 1976 to 24.2 percent in 1988. This conclusion is surprising in light of the widespread perception that the service sector of the U.S. economy has grown very rapidly and that durable-goods manufacturing has undergone a serious decline. It is true that durable-goods purchases were depressed in post-recession year 1976, but their share of GNP at a healthier stage of the business cycle in 1978 was only 21.9 percent. Indeed, value added by U.S. durable-goods manufacturing industries (in 1982 dollars) rose from 12.6 percent of GNP in 1976 to 13.6 in 1978 and 14.2 percent in 1988. This observation is discussed further below.

The projections imply that sales of U.S.-made durable goods will grow considerably more slowly from 1988 to 2000 than in the previous twelve years. The projected rate of 2.6 percent annually, however, is still greater than the projected growth of GNP. Durable-goods purchases would continue to grow as a share of GNP from 24.2 percent in 1988 to 25.4 percent in 2000. [21]

In projecting U.S. *production* of durable goods, it is assumed that no further reductions in inventory-to-sales ratios will be achieved. Retail (consumer) purchases of durables, moreover, are projected to grow at a much reduced rate through the end of the century (see Table 2 above). Hence it is projected that production growth will no longer lag but will equal the growth in sales of U.S.-made durables. This result is entered in Table 3. Durable-goods production in constant dollars would continue to increase its share of GNP from 14.2 percent in 1988 to nearly 15 percent in 2000. This increase would be likely to take place at the expense of construction activity and perhaps of mining and government services and would come as a surprise in light of perceptions about the dubious vitality of manufacturing industries. [22]

This phenomenon can be attributed to the projected rapid growth of U.S. exports and the improvement in the balance of U.S. international trade. Domestic purchases of durable goods are projected to grow at about the same rate as GNP, as faster growth of business investment in machinery and equipment is offset by slower growth of building components and a decline in government purchases due to shrinking procurement for the military. Consumer purchases are projected to grow at about the same pace as GNP.

This observation puts the spotlight on the projection of the balance of durable-goods trade, one of the most difficult aspects of the picture to forecast accurately. The balance of trade in durable goods was projected in Table 2 (p. 76) to rise by more than one percent of GNP from −1.2 percent in 1988 to zero in 2000. If no improvement takes place in durable-goods trade, on the other hand, total purchases of U.S.-made durables would rise at a projected rate of 2.3 percent annually, only slightly faster than GNP, and their share of GNP would increase only slightly from 1988's (albeit rather high) level. If the improvement in the trade balance is greater, which is entirely possible, rising for example to a surplus

[21] This would be an increase of 3½ percentage points from 1978.

[22] It also would come at the expense of the shrinking share of GNP derived from the rest of the world, mainly the balance of international flows of investment income. This balance has declined in the past several years as foreign investment in the United States has outpaced American investment abroad.

of one percent of GNP (circa $50 billion), then purchases of U.S.-made durable goods would rise to 26.2 percent of a somewhat larger GNP and would grow at a compound rate of 2.9 percent instead of 2.6 percent annually.

Conclusions

Substantially slower labor-force growth foreseen for the future portends somewhat slower long-term economic growth, although part of the restraint imposed by tight labor supplies may be offset by faster growth of labor productivity if firms invest more in labor-saving technology and managerial efficiency. The long-term potential for GNP growth (labor-force plus labor-productivity growth) is widely expected to slow from about 3 percent annually prior to 1988 to the range of 2 to 2½ percent in the 1990s.

Within this picture the manufacturing sector is subject to a variety of cross-currents. Despite the well publicized travails of certain industries, like steel, autos and machine tools, and wider-ranging problems in the mid-1980s that stemmed from an overvalued exchange rate, the performance of U.S. manufacturing over the longer term does not present a picture of general decline. From 1976 through 1988 the value of manufacturing output, excluding price changes, grew by 3.5 percent per year, considerably faster than GNP (2.9 percent). Durable-goods industries—the heart of the defense-production base—grew at 3.9 percent. Even from 1978 to 1988, a period less influenced by business-cycle fluctuations, the same comparison holds with somewhat less contrast (see Appendix A, Table A1 below).[23] Nondurable-goods industries grew in step with GNP.

Second, some of the long-term slowdown in housing starts foreseen for demographic reasons is likely to be offset by increases in the average size and quality of new homes built in the 1990s as the baby-boom reaches middle age. The expected prolonged recession in office and commercial construction, moreover, could be offset by renewed construction of electric-power plants and increases in other industrial construction and in infrastructure maintenance and improvement. Boosts in public construction, such as roadbuilding and wastewater projects, depend of course on the provision of public funding at a time when growth in government revenues will be slowing together with GNP.

Purchases of building components may not decline absolutely but their growth is projected to slow further from its already slow pace (see Table 2). While a backlog of construction needs is evident, the current accrual of such needs should slow with population growth, so that the market for construction and the materials and facilities that go into it, although perhaps sustained in the 1990s, can be expected to enter a long-term decline sometime after the turn of the century unless population trends change.

Growth in consumer purchases of durable goods, including automobiles, is projected to slow by more than half (see Table 2). Adding to this slowdown is likely to be a sharp downturn in Feder-

[23] A significant part of the growth of durable-goods industries is attributable to the surging output during these years of the computer-manufacturing sector, which is measured in part by improvements in the performance of its products.

al Government procurement of military equipment after the rapid buildup of the 1980s. Assuming a cutback in real procurement of 25 percent over five years, purchases of durable goods by the Government for the military would retrace between 1992 and 1997 about 40 percent of its steep increase from 1976 to 1988.

However, the impact on manufacturing industries of a slowdown in purchases of building components, consumer durables and military equipment is expected to be cushioned to a considerable extent by a rising balance of trade in durable goods. Undergirding all industries with important stakes in the balance of trade—both exporting and import-competing sectors—may be a competitive exchange rate for the U.S. dollar in a dynamic world market for the restoration of infrastructure and modernization of industry. This effect would cut across many parts of manufacturing. America's strong position in world trade in capital goods—machinery, construction and oil drilling equipment, electrical and electronic equipment, aircraft and instruments—should boost the fortunes of these industries as the Nation's trade balance improves. A lower exchange rate also could help import-competing industries like motor-vehicles and textiles to contend more successfully for the limited growth expected in their markets. Private domestic investment in durable equipment also is projected to increase at a healthy pace.

Based on the assumptions embodied in Table 2, including an assumption that the U.S. trade deficit in durable goods will be eliminated by the year 2000, durable-goods production would grow at a long-term rate of 2.6 percent annually from 1988 to 2000. This rate would be one-third slower than during the previous twelve years but still greater than the 2.2-percent growth rate projected for GNP, which would slow by about one-quarter. Durable-goods manufacturing would increase its share of GNP from about 14 to nearly 15 percent in constant dollars. Nondurables purchases are projected to grow at about the same rate as GNP.

Given the major role of durable goods among U.S. exports, this assumption would seem to be a plausible one. If no improvement in the trade balance occurs, however, U.S. production of durable goods would rise at about the same rate as GNP, for domestic purchases of durables are projected to grow at about this rate. If, on the other hand, the improvement in manufacturing trade is greater, the output projection would have to be boosted correspondingly. Like the backlog in construction needs, however, this source of growing demand for U.S. manufactures is likely to lend support for a few years but then to fade away as a source of growth.

This examination of potential factors, demographic and other, that will influence demand for U.S.-made manufactured goods leads to the conclusion that manufacturing, in particular durable-goods production, will continue to grow somewhat faster than the economy as a whole. American steel firms may nonetheless encounter further setbacks because of the slowing auto and construction markets and the continuing shift to lighter-weight materials in vehicles, although a lower exchange rate could permit them to make inroads against imports, and an export boom in capital equipment would help. American auto firms also can expect a continuation of very sluggish markets. International competition for textile and leather-goods markets, already under government restraints, seems

so relentless that little growth of these industries seems likely in high-wage countries.

Other sectors of American manufacturing, meanwhile, continue to grow at healthy rates. Because some of the sources of their growth may prove transitory, and because of intensifying competition in mature industries from producers in other nations, high-wage countries like the United States must use their strong research capacity to spawn new industries and subindustries based on new technologies. Emerging technologies in which U.S. firms are world leaders include biotechnologies, environmental and space technologies and information technologies (advanced computer systems and software). The United States also has a strong research footing in advanced materials, materials processing and engineering technologies.[24] Struggles currently are proceeding in Congress and between Congress and the Bush Administration on the extent and means by which Government should assist the private sector in the commercialization of such technologies.

Appendix A

Performance of Sectors and Manufacturing Industries, 1978–1988

Greater understanding of the evolution of the economy's structure can be gained from a closer examination of the output growth of sectors and industries over the past several years. This examination is assisted by newly revised data on the breakdown of real GNP by industry that were published by the Department of Commerce in January 1991 and updated further in April. This breakdown had been an object of criticism and controversy during the later 1980s, and the new numbers are based on improvements in methodology, although they make little change in the reported pattern of output. The newly published figures cover only the years, 1977 through 1989. Revised data for other years will be published at a later date.[25]

Table A1 indicates the relative size of major sectors of the economy in 1978 and 1988 respectively and their compound annual rates of growth between these years. These two years are chosen for comparison because each one occurred during a comparable stage of a business cycle, minimizing the impact of the cycles themselves on the comparison.

As we know from the discussion above, the output of manufacturing measured in real terms grew somewhat faster than GNP from 1978 to 1988 and boosted its share slightly. Production of durable goods grew considerably faster, while nondurables lagged slightly behind the larger economy. Durable goods industries and certain others (especially communication, wholesale and retail trade, and service industries) outstripped the pace of GNP growth and gained relative to the extractive industries, construction, and

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[24] See Council on Competitiveness, *Gaining New Ground: Technology Priorities for America's Future*, Washington, D.C., March 1991, 77 p.

[25] De Leeuw, Frank, Michael Mohr and Robert P. Parker, Gross Product by Industry, 1977–88: A Progress Report on Improving the Estimates, *Survey of Current Business*, v. 71, no. 1 (January 1991), p. 23 f. Also, Michael F. Mohr, Gross National Product by Industry, 1987–89, *Survey of Current Business*, v. 71, no. 4 (April 1991), p. 25 f.

government, which were shrinking relative to the size of the economy. Extractive industries, particularly oil and gas extraction, were declining absolutely.

TABLE A1. Size and Growth of Major Sectors of the Economy

1978 to 1988

Sector	Percents of GNP		Compound annual growth rate
	1978	1988	
GROSS NATIONAL PRODUCT	100.0	100.0	2.6
PRIVATE INDUSTRIES	86.6	89.7	2.9
Agriculture, Forestry & Fisheries	2.3	2.3	2.6
Mining	4.8	3.2	−1.5
Construction	5.4	4.4	0.6
Manufacturing	22.3	23.0	2.9
Durable goods	13.6	14.5	3.2
Nondurable goods	8.7	8.6	2.4
Transportation	3.8	3.7	2.2
Communication	2.1	2.7	4.8
Electric, Gas & Sanitary Services	3.1	3.3	3.2
Wholesale Trade	5.8	7.4	4.9
Retail Trade	9.1	9.9	3.3
Finance, Insurance & Real Estate	14.2	14.5	2.8
Services	13.5	15.3	3.8
GOVERNMENT & GOVERNMENT ENTERPRISES	11.9	10.5	1.3

SOURCES: Gross Product by Industry, 1977-88: A Progress Report on Improving the Estimates, *Survey of Current Business*, v. 71 (January 1991), p. 34, Table 6. For updated figures for 1988 see Gross National Product by Industry, 1987-89, *Survey of Current Business*, April 1991, p. 77, Table A.)

Greater insight into the dynamics of manufacturing can be obtained by examining the diverse fortunes of its 21 major industries (see Table A2). Policy makers and the public have heard a great deal from sectors suffering absolute declines, namely primary metals (−3.3 percent per year), motor vehicles (−1.2 percent), and leather products (−5.2 percent). Tobacco producers, whose output has fallen by 7.4 percent annually, have enjoyed less public sympathy. Textile mills, apparel and other textile product makers, and stone, clay and glass producers also have experienced very little growth.

Large sectors of manufacturing, however, have seen healthy growth, led among durables producers by nonelectrical machinery (especially computers), electric and electronic equipment, transportation equipment other than motor vehicles (mainly aircraft), and instruments. The role of these sectors as principal American exporting industries has sustained their growth since 1988 and promises to give them an expanding role in the 1990s.[26] Among nondurable-goods producers, the rapid growth of output of petroleum and coal products and of rubber and miscellaneous plastic products has offset slow growth or decline in other sectors. Manufacturing (i.e., refining) of petroleum and coal products has grown rapidly, despite the decline in extraction of crude oil, because of increases in imports of crude.

[26] The very high growth rate attained by the nonelectrical machinery industry depends heavily on the rapid improvements in performance of computer equipment, which count as increases in real output for this sector.

There is no indication in these data of a generalized decline of U.S. manufacturing industries. On the contrary, in terms of real output, durable-goods industries have grown as a share of GNP in the 1980s, despite some well-known weak sectors. Computer manufacturing has been a stand-out sector that has grown much faster than others, and some controversy exists about the validity of output measurement in this sector. Manufacturing of nondurable goods has roughly held its own as a share of the economy.

TABLE A2. Relative Size & Growth of 21 Manufacturing Industries

1978 to 1988

Sector	Percents of GNP		Compound annual growth rate
	1978	1988	
DURABLE GOODS	13.6	14.5	3.2
Lumber & wood products	0.5	0.6	2.9
Furniture & fixtures	0.4	0.3	1.0
Stone, clay & glass products	0.7	0.6	0.8
Primary metals	1.7	0.9	−3.3
Fabricated metal products	1.7	1.6	1.7
Nonelectrical machinery	2.6	4.2	7.5
Electric & electronic equipment	1.8	2.2	4.5
Motor vehicles & equipment	1.9	1.3	−1.2
Other transport equipment	1.1	1.5	5.6
Instruments & related products	0.7	0.8	4.4
Miscellaneous manufacturing	0.4	0.4	2.1
NONDURABLE GOODS	8.7	8.6	2.4
Food & kindred products	1.8	1.7	1.8
Tobacco manufacturers	0.3	0.1	−7.4
Textile mill products	0.5	0.4	0.1
Apparel & other textile products	0.7	0.6	0.8
Paper & allied products	0.9	0.9	1.9
Printing & publishing	1.2	1.1	2.3
Chemicals & allied products	1.8	1.8	3.0
Petroleum & coal products	0.7	1.1	6.8
Rubber & miscellaneous plastic products	0.6	0.7	4.5
Leather & leather products	0.2	0.1	−5.2

SOURCE: Gross Product by Industry, 1977–88: A Progress Report on Improving the Estimates, *Survey of Current Business*, v. 71 (January 1991), p. 34, Table 6.

Appendix B

The Relationship of Stock Replacement and Growth in Usage of Long and Short-Lived Products

With no growth in usage of a long-lived product, the total demand for new production equals the demand for replacement of existing stock,

$$\frac{1}{l} \times S_t$$

in which $S(t)$ represents the outstanding stock of the item in the current year, and l equals the service life in years.

If the stock is growing steadily, however, then each year's demand for new production will equal the demand to replace worn-

out components of the pre-existing stock plus the demand for additions to the stock. If the rate of growth in usage equals r, then

$$Expansion\ demand = rS_t$$

and

$$Replacement\ demand = \left(\frac{rS_t}{e^{rl}} + \frac{rS_t}{e^{2rl}} + \frac{rS_t}{e^{3rl}}\right) + \ldots + r\left(\frac{S_t}{e^{rnl}}\right).$$

in which the first term to the right of the equals sign represents the investment in growth one lifetime ago that now requires replacement, and the remaining terms represent replacement coming due from all earlier generations of investment in the item.

Hence total demand for new production equals

$$Expansion + Replacement = rS_t + \frac{rS_t}{e^{rl}} + \frac{rS_t}{e^{2rl}} + \frac{rS_t}{e^{3rl}} + \ldots + \frac{rS_t}{e^{rnl}}$$

or

$$rS_t + \left(\frac{rS_t}{e^{rl} + e^{2rl} + e^{3rl} + \ldots + e^{rnl}}\right)$$

If l equals 60, as in the case of housing, and r equals 0.02, as in the 60 years from 1920 to 1980, then the expansion demand is 2 percent of the present stock, and replacement demand (summed through eight iterations and rounded upward) comes to 0.9 percent, as shown in Table 1 of this section.

If l equals only 10, however, as is approximately the case of heavy equipment installed in buildings (water heaters, air conditioners, etc.), and r equals 0.02, the expansion demand remains 2 percent of the present stock, but replacement demand is much larger. Summed through 20 iterations and rounded upward, replacement demand comes to 9 percent of the stock.

V. DEMOGRAPHY AND HOUSING IN THE 1990s

by Barbara L. Miles *

Throughout the period since World War II, the net growth of the housing stock has generally correlated with net household formations. [1] That is, over the long haul, despite cyclical swings in interest rates, prices, incomes or other measures of affordability and profitability, demography has been, and is, the major long-run determinant of housing trends. In particular, it is the forming of new households and the dissolution, reformation or other changes in old ones, rather than simple population changes which matter. Of course, household arrangements are themselves affected by incomes, prices and the like, so that there are economic as well as social factors embedded in demographic considerations. Taking that into account, the current changes in the Nation's demographic profile have serious implications for both the increase and the nature of housing in the coming years.

Trends in Household Formation

Household changes in the 1990s will reflect mainly the maturing of the "baby boom." The baby boomers are those who were born between about 1946 and 1964, a period when the Nation's population jumped 18.6 percent, with the peak birth years occurring in the late 1950s. The oldest of those born during that span are in their mid-forties at the beginning of the 1990s, and the youngest will be in their late thirties by the end of the decade. The majority of the group has already formed independent households and the post-boom population, which is now of prime age for new household formation, is smaller than the boom generation.

A SLOWDOWN IN NET HOUSEHOLD FORMATIONS

A slowdown in net household formations is, therefore, the overall trend which is expected to dominate the 1990s. The Census Bureau's mid-level projection [2] anticipates that net household formations will average 1.2 million per year through about 1995 and 1.1 million per year from then through 2000, dramatically slower than the 1.7 million of the 1970s when the baby boomers were first coming of age, and continuing the slowdown of the 1980s (see Table 1). The pattern of households reflects more than simple population

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[1] A household is defined as a person or group of persons who occupy a house, apartment, room, or group of rooms intended for use as separate living quarters. Institutional or group quarters are not households.

[2] U.S. Department of Commerce. Bureau of the Census. *Projections of the Number of Households and Families: 1986 to 2000.* Series P-25, No. 986. Washington, 1990.

increases, of course. Social developments—later marriages, changing divorce rates, the increasing importance of single-person households—all matter. Along these lines, the Census projections assume that the entry of the baby-boom population into older age groups or cohorts, which tend to have more stable family patterns than younger groups, will result in a moderation of the marriage and divorce trends of the 1970s: that is, marriage rates (including remarriages) will increase somewhat, and divorce rates will slow their rise or decline. Both of these expected tendencies should act to slow household formation, the former because it tends to combine two independent households (particularly in remarriages), and the latter because it reduces splitting of single households into two. In the 1970s and to a lesser extent in the 1980s, both of these factors were working in the opposite direction, resulting in greater household growth than would have been expected otherwise, and a very sharp decline in average household size. An additional factor affecting the 1990s, the tendency which began in the early 1980s for young adults to delay forming independent households, is assumed to continue, reinforcing the projection of slower household formation. The end result is an anticipated increase of nearly 12 million households over the full decade to about 106 million American households by the year 2000.

Economic changes as well—real income and wealth changes and relative housing costs—have effects which can alter household formation at least temporarily, as during a recession or a period of exceptionally high interest rates. At least some of the slowdown which occurred in the early 1980s likely reflected the recession-related income losses and high real housing costs of that period. The Census projections do not take such matters into account, thereby implying an assumption of stability in economic trends. Over long periods, this is a fair enough assumption. A dramatic event which affects the economy, however, could alter the timing of the underlying trends significantly. The Census Bureau's own models of possible economic scenarios, for example, show that slow income growth and high real housing costs over the period could result in 2.1 million fewer households being formed, thus lowering the annual average to a little under 1 million over the period. At the other extreme, an unexpectedly strong economy, with relatively low real housing costs, could induce as many as 4.8 million additional households, raising the annual formation rates to around 1.6 million, nearly the experience of the 1970s. At the beginning of the 1990s, conditions approximate the lower end of the spectrum and household formation appears to be quite low—perhaps only 750,000 for 1990. Nonetheless, there is little reason to expect that rate not to rebound, or to reject the mid-level projections.

THE CHANGING COMPOSITION OF HOUSEHOLDS

The changing composition of households is a second major trend which is expected to continue through this decade, although it too is dependent upon certain assumptions about economic and social conditions. The most significant trends affecting the decade of the 1990s are two: those stemming from age-group shifts and those concerning household size.

TABLE 1. Net Household Formation

Annual Averages

Period	Number of Households	Average Number of Persons (end of period)	
		Per Household	Per Family
1950–1960	904,000	3.33	3.67
1960–1970	1,060,000	3.14	3.58
1970–1980	1,738,000	2.76	3.29
1980–1989	1,340,000	2.62	3.16
Projections			
1990–1995	1,216,000	—	—
1995–2000	1,125,000	2.48	3.07

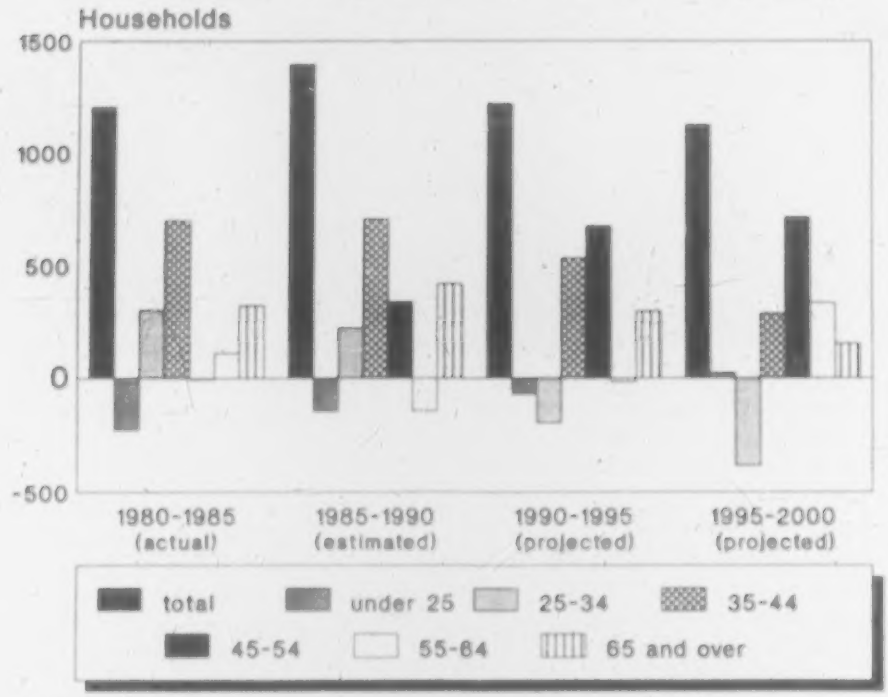
NOTE: Families are a subset of total households that excludes single-person households and unrelated persons sharing living quarters.
SOURCE: U.S. Department of Commerce, Bureau of the Census, Series P-25, #986, Series P-20, #441

The age-group shifts are fairly straightforward: because the largest population groups are becoming clustered in the 35- to 54-year-old age cohorts, those cohorts will also have the largest net increases in the numbers of households (Figure 1). This is partly due to formation of new households within the age group, but is more a matter of the maturing of households already formed at younger ages. By the year 2000, households headed by persons in these groups are expected to comprise 44 percent of all households, their increase accounting for nearly 60 percent of the overall increase in the number of households in the 1990s.

By contrast, there will be declines in the number of households made up of younger adults, a trend which began in the early 1980s as the majority of the baby-boom generation moved into their late twenties, resulting in additions to the household totals for the 25- to 34-year-old age cohort. In the 1990s this trend continues, but the households are now in the next older age group. Thus, the number of households headed by persons under 35 years of age will decline absolutely as well as relatively throughout the decade. The projected decline in the first half of the 1990s for households in the 55- to 64-year-old group, which also dates from the late 1980s, reflects the very low rate of births during the Great Depression of the 1930s. This dip is reversed when the baby-boom population reaches that age group early in the next century. Sharp increases in the 65-and-older population can be expected in turn, but will have most of their impact after 2010.

Changes in household size reflect both smaller families (Table 1) and increasing importance of non-family households. Both trends are of long standing and reflect important social changes. In 1950, traditional married-couple families were fully 78 percent of all households (the peak since World War II), but by 1989, because they increased in number less rapidly than other household types, they comprised only 56 percent. By 2000 they are expected to decline to 53 percent. That suggests that less than one-third of the net household increase in the 1990s will be traditional households. Other types of families, including single-parent families, which increased dramatically in the 1970s but have subsequently slowed and are now about 15 percent of all households, rise only a little in

FIGURE 1. Annual Change in Number of Households by Age Group



Source: U.S. Department of Commerce. Bureau of the Census.

importance and should make up less than one-fifth of the 1990s' household growth. Within that group female-headed families far outnumber male-headed families. Thus, at the same time that families are tending to have fewer members, they are forming less rapidly than other households and becoming a relatively smaller share of the overall household composition. All types of family households, taken together, should increase about 5 million over the decade, just under half the total growth.

The group becoming more important is that of non-family households, about 90 percent of which contain only a single person. Single-person households are expected to account for just under half of the 1990s' household increase and comprise about 30 percent of all households by 2000. While some of this increase is due to the rise in the number of elderly persons living alone, especially women, a greater part will be found among basically the same middle-aged group which accounts for the 1990s population bulge generally. That is, trends are exhibiting a decided increase in middle-aged persons living alone, whether never married, divorced or widowed. By 2000, single-person households will be less elderly than historically (about 38 percent over age 65, down from 40 percent in the 1980s), less young (about 19 percent 35 years of age or younger, down from about 25 percent in the 1980s), and more middle-aged (about 43 percent, up from about 35 percent). Non-

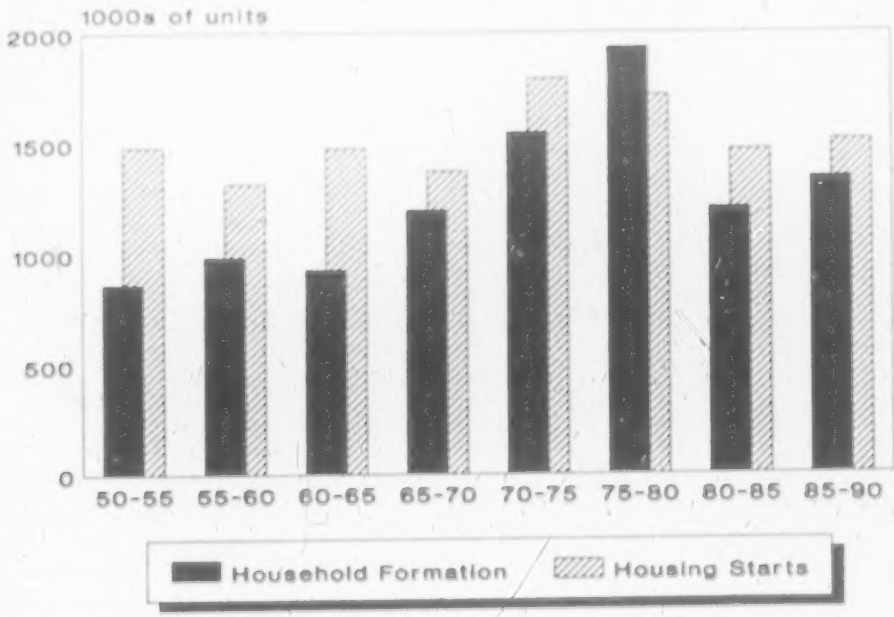
family households as a group are expected to increase about 6 million—more than half the total increase—in the 1990s.

The most important demographic factors for the housing industries in the 1990s, therefore, are first, the slower overall rate of household increase; second, the increasing importance of middle-aged households; and third, the sharp rise in importance of single-person, also substantially middle-aged households.

Implications for Housing

Even though demography provides the most important variables determining changes in housing demand over the long run, the number of new houses built is not identical to net household formation. In any period, housing starts include a component for replacement of units destroyed or converted to other uses as well as for net additions, and vacancies in the existing stock will become either occupied or more numerous. Such a statement seems obvious, but how it plays out in the housing sector is complicated by yet more factors. Declining real incomes for a part of the population—as with female-headed households—may lead to intensive use of units that might otherwise have been replaced, or even subdivision of existing units rather than new housing; increasing importance of wealthier and higher income groups—for example, the middle-aged—may lead to expansion for some types of housing despite high vacancies in other types—such as so-called "starter homes"; and any changes in interregional migration or mobility patterns may result in a changed "normal" level of vacancies to accommodate those patterns.

FIGURE 2. Housing Starts and Household Formation



Source: U.S. Department of Commerce. Bureau of the Census.

Over the period 1950 to 1989, housing starts outnumbered household formations by about 5 to 4. But the ratio declined over time (see Figure 2): from about 56 percent higher in the 1950s, to about a third higher in the 1960s, and about even in the 1970s when household formation was at record high rates. In the 1980s, housing starts were about 12 percent above the net household formation rate which, in the wake of the baby boomers' initial entry into housing markets, was already slowing.

In the 1990s, the continuing overall slowdown in net household formation is widely anticipated to result in fewer new housing units constructed. But to the extent that replacement of housing continues at other than "usual" rates, or current vacancy rates prove to be other than needed to accommodate mobility, this outlook will be modified. Changes in the demographic composition of households, on net, tend to reinforce the thesis of slower, but fancier, new construction. That is, an increase in middle-aged households in their peak earnings years who tend to live in larger and more amenity-filled units implies high-quality additions to the housing stock; but expected decreases in mobility as households age imply less use for vacancies, which in 1990 are relatively high in any case. The interaction of these factors, absent any change in investment or other economic incentives, suggests new housing (including mobile home shipments) on the order of 1.3 to 1.5 million units per year on average through the 1990s.

HOW THE HOUSING STOCK IS OCCUPIED

As of 1990 there are about 106 million housing units in the housing stock, 94.2 million of which are occupied year-round. [3] Major implications for changes to this stock, beyond the question of "how much," arise from the tendencies of certain categories of households to live in certain types of housing units.

Married-couple families, who will be increasing in absolute numbers even while decreasing relative to other demographic groups, have two housing propensities affecting use of the stock. First, they are disproportionately likely to live in single-family homes: in the 1980s, while comprising just over half of all households, these families occupied about four-fifths of single-family homes. Second, the older the family, up to retirement age, the bigger the house is apt to be. [4] By contrast, single-person households, which are growing in

[3] A non-demographic question concerning future housing demand has to do with replacement of existing stock. The replacement factor is less of an impetus to new construction than at one time. This is partly because two-thirds of the current stock was built within the last 40 years and is years from replacement. It is also because there is simply less substandard housing than in the past the 1987 American Housing Survey put the proportion of occupied housing with severe physical problems at less than 1percent and those with less serious deficiencies at about 5 percent. It is probably also because, with increasing standards and construction codes, at least some "replacement" takes the form of continual alterations, remodeling, and major repairs which extend the physical and economic life of houses; such actions have a clear economic impact on national production, but do not result in new housing starts. Current estimates of replacement needs are now on the order of two-tenths of 1 percent, or about 230,000 units per year.

[4] See Pitkin, John R., and George Masnick. *Households and Housing Consumption in the United States, 1985 to 2000, Projections by a Cohort Method*. Joint Center for Housing Studies of the Massachusetts Institute of Technology and Harvard University, Cambridge, Mass., May 1986.

both absolute numbers and relatively, are disproportionately likely to live in buildings with five or more units: in the 1980s, singles were about a quarter of households, but occupied nearer one-half of apartments in such larger buildings. This latter tendency is moderating, however, because, similarly to married households, the older the single-person household, the more likely that he or she will live in a single-family home, at least of mid-size. Presumably this latter phenomenon, which continues into old age, reflects the likelihood of being widowed at some point as much as or more than it does the space preferences of maturing divorced singles or never-marrieds.

These patterns demonstrate not only different space needs but different income profiles. Historically American households have demonstrated life-cycle patterns of income, rising from low levels for young households to peaks in middle age, and declining again after retirement age (Table 2).

The trends toward middle age and toward single-person households are somewhat offsetting, but on balance, favor the single-family sector of the housing market through the 1990s. Certainly the 1990s will be favorable, in terms of average age and income profiles, to more expensive types of housing. This is almost entirely a function of the baby-boom generation's reaching its peak earnings years. There are, nonetheless, subgroups which vary considerably from the average: female-headed families, whose median income is less than half the average for all households, and at the opposite extreme families in which both husband and wife work, whose median incomes average nearly 20 percent higher than for other married-couple households.

TABLE 2. Median Income of U.S. Households and Families by Age: 1989

Age Group	All Households	Families		Non-Family Households
		Total	Couples	
Total	$28,906	$34,213	$38,664	$17,115
Under 25	18,563	17,064	23,441	19,401
25 to 34	29,823	30,873	40,726 *	26,581 *
35 to 44	37,635	40,202		
45 to 54	41,523	46,101	46,245 *	18,483 *
55 to 64	30,819	37,643		
65 & over	15,771	23,083	23,424	9,638

* 25 to 44
* 45 to 54
SOURCE: U.S. Department of Commerce, Bureau of the Census, *Money Income and Poverty Status in the United States: 1989*, Washington, 1990

Demographic patterns also reveal an increase in Hispanics and African-Americans as a proportion of all households, especially of families. These households are more likely than the average to live in housing which has moderate or severe physical problems, and have less income on average to deal with them, although their life-cycle income patterns are not different from the majority population. They are also somewhat less likely than other households to

occupy single-family houses, at least as renters.[5] The increasing importance of these two groups, especially Hispanic households, which tend to be both larger and younger than the average, may have interesting implications for integration patterns and fair housing policies. Landlords and home sellers may attempt to neglect or reject this growing segment of the market at their economic peril. That is, illegal housing discrimination may well become more costly for those who would practice it, even in the absence of law enforcement.

THE IMPACT ON TENURE

Household propensities toward tenure—whether to own or rent—and type of housing unit are related—three-quarters of single-family houses, but only about one-ninth of other units, are owner-occupied. It is, thus, no surprise that owners bear strong resemblance to single-family home occupants. For tenure, however, income is the single most important differentiating factor between owners and renters. That is, the older (up to very old age) but especially the higher-income a household is, the more likely it is to own rather than rent its abode. Furthermore, married-couple households are more likely to own, and to own larger units, than single persons or other types of households. Female-headed families, especially young ones, are least likely to own any type of unit. On net, the maturing of the baby boom should reverse the pattern of the 1980s and raise homeownership rates through the 1990s.

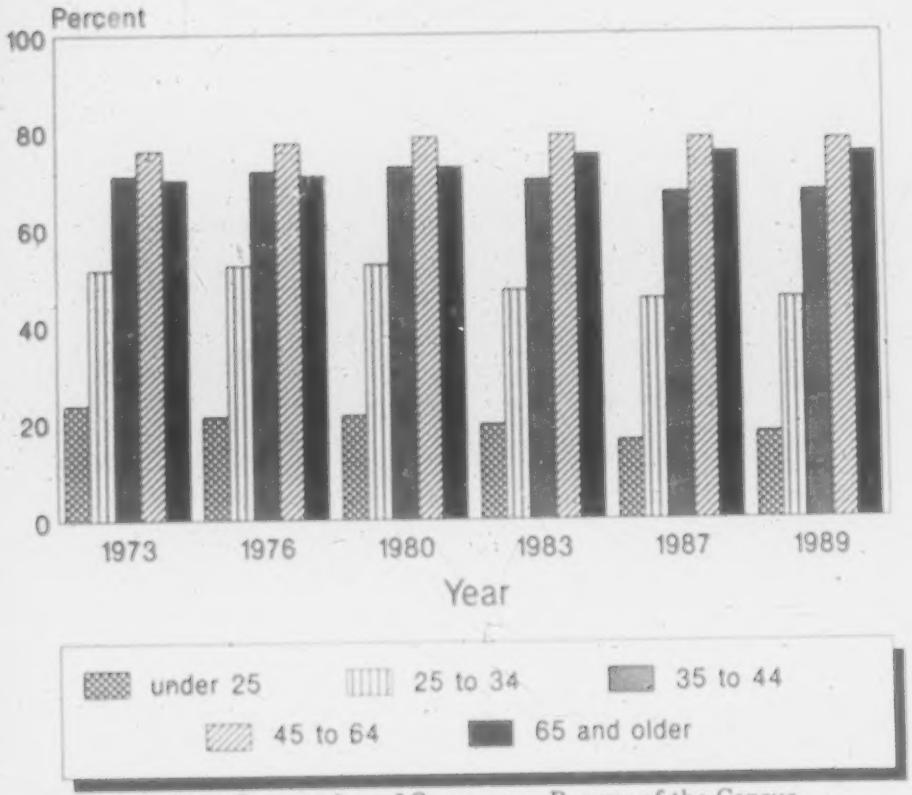
Homeownership

Just as most of the baby-boom generation had already formed independent households at the beginning of the 1990s, so most are also already homeowners. If historical patterns are followed, an even higher proportion of them will become owners before the end of the decade (Figure 3). By contrast, members of the under-35-year-old age group, in which first-time home purchase is most common, are fewer and, as a result, even as they become owners, whether at historically "normal" rates for their age group or not, they will have less of an impact on the housing industry than their predecessors did at the same age.

Simple maturing of the largest part of U.S. households to the age groups with the highest propensity for homeownership implies rising ownership overall, if age-related ownership rates remain stable, or even if they fall somewhat. Age-specific ownership rates, in the absence of other factors, imply that about 67 percent of all households will own their homes by the end of the decade. There are, of course, offsets to age changes, and ownership rates have been falling for certain groups. Single-person, and single-parent households, for example, have much lower homeownership rates than married-couple families, and their increased importance has acted to lower the overall ownership rate in the 1980s. A seminal study by the Bureau of the Census issued in 1986 calculated ownership rates by household type as well as age group and concluded

[5] U.S. Department of Housing and Urban Development. And U.S. Department of Commerce. Bureau of the Census. *Household Characteristics of Selected Races and Hispanic-Origin Households in the United States: 1987.* Washington, 1989.

FIGURE 3. Homeownership by Age Group
1973-1989



Source: U.S. Department of Commerce. Bureau of the Census.

that, under the most reasonable household formation and income assumptions, the overall home ownership rate could reach 67.8 percent by 2000.[6] Other studies have reached similar conclusions, when demographic changes alone are taken into consideration.[7]

Implications For Housing Prices

Nonetheless, the fact of fewer households in the typical first-time-buyer age groups has led to speculation that housing prices would collapse along with the rate of new construction. The concern is not entirely misplaced: slower household growth does signal lessened demand pressure on housing markets for both rentals and ownership. Furthermore, housing markets are geographically seg-

[6] Pitkin and Masnick, *Households and Housing Consumption*. The rates projected in this study, however, are higher than actually experienced for intermediate years. A rate of about 66 percent was projected for 1990, for example, but the actual rate appears to be about 64 percent. Nonetheless, adjusting for this discrepancy still implies a higher rate in 2000 than in 1980, the highest rate so far.

[7] See, for example, DiPasquale, Denise, and William C. Wheaton. *Housing Market Dynamics and the Future of Housing Prices*. (Draft) Harvard-MIT, Cambridge, Mass., May 1990.

mented, and local areas can experience severe declines even while the rest of the country is strong. The popular forms of much of this pessimistic analysis tend, however, to overemphasize the importance of the decline in additions to households as if the rising age structure had no offsetting effect. [8] An expansion of this argument presumes a reinforcing decline in propensity for ownership as the likelihood of sizeable capital gains declines, or total stagnation in "starter-house" markets which will stop any move-ups by current owners unable to sell to the dearth of young households. The argument is not wrong, but is probably overstated.

To place the matter in context, household formation in the 1990s, while slower than in the previous two decades, will still be greater in absolute numbers than in any decade prior to the high-growth 1970s; the population is still expanding. While slower household formation does indicate fewer needed additions to the housing stock, it is not the whole story. Existing home sales are much greater than new sales and, as the stock increases, so does the ratio of resales to new sales. Through the 1970s, resales were 4.3 times new sales, and in the 1980s, the ratio was five. In the 1990s, both because of declining numbers of new houses and increasing resales, the ratio is likely to top six. This occurs because resales are sensitive to the overall number of households, and that number continues to increase. Another way to look at resales is the turnover rate, or the ratio of resales to total households (or housing stock). That ratio was high in the 1970s, but fell in response to affordability problems in the 1980s. If the 1990s turnover ratio only matches that for the 1980s, resales should increase to an average of about 3.5 million houses per year, compared to about 3 million in the 1980s and 2.9 million in the 1970s.

Furthermore, the "collapse scenarios" appear to contend that the price increases of the 1970s were entirely a matter of the huge demographic pressures of that period. In fact, the rapid inflation of that period distorted the impact of other factors substantially; that is, it led to an unusually strong appeal of housing as a highly leveraged hedge against further inflation and erosion of the value of other household financial assets. In addition, interest rates, which have been the most important determinant of housing cycles as opposed to trends, were low relative to inflation rates and even negative on an after-tax basis. Thus, the cost of home ownership, after taking taxes and inflation into account, was unusually low, even though the nominal cost appeared to be rising very rapidly. Finally, the quality and amenities of housing sold during that period were also rising (as is usually the case), so that at least some of the

[8] The analysis most commonly put forward, for example, postulates a demand pattern of peak housing consumption occurring when households are in their late thirties and steady decline with age thereafter. Mankiw, N. Gregory, and David N. Weil. *The Baby Boom, the Baby Bust, and the Housing Market.* NBER Working Paper 2794. Cambridge, Mass., December 1988. Such a pattern implies that the rising age structure is reinforcing rather than offsetting the impact on housing demand of slower household formation rates. It appears, however, that the historical data do not portray a life-cycle, but rather, are measuring intergenerational differences: that is, the data are measuring the higher incomes and, therefore, higher housing consumption, which were expected over the lifetimes of younger generations (in the 1950s through 1970s) compared to older ones. In contrast, the DiPasquale and Wheaton model (see footnote7) estimates that about two-thirds of the decline in housing demanded due to the slower household growth is offset by the maturing household age structure. The net demographic effect is small, about 1.5 percent, and has only small price effects.

price increases were actually due to quality increases, and those are normally related to rising incomes, not rising numbers of households.

In the absence of a deflation or prolonged contraction of the economy, it would be a mistake to think of the 1990s as simply a downside version of the 1970s. There is no particular reason to believe that the investment motivation for buying housing, in the form of homeowners' capital gains, will be significantly different in the 1990s from what it was in the 1980s (when it was clearly weaker than in the 1970s). If inflation remains in check, then real interest rates may decline from 1980s rates, increasing affordability. This could release some of the pent-up demand represented by the large number of baby-boom households—2.7 million—who still have not become owners when they could have been expected to by now, given age-related homeownership rates of 1980.

As for the prospective weakening of the starter-house market, while probably true, when taken too far this argument overlooks the tendency of yesterday's starter houses to become today's well-located move-up homes. That is, many of the far-out-in-the-suburbs starter homes of twenty years ago are now located in suburban employment and shopping "rings." Not only have jobs moved out to suburbanites, but schools, roads, other transportation and amenities have "caught up" to them as well. In housing markets, location matters more than amenities, which are often added in later remodeling anyway. In fact, over the long haul, existing house prices have tracked other prices fairly well, with land costs for new construction accounting for real appreciation rates; and, except for the 1970s, prices have moved pretty much in line with family income changes. These are the main factors which should be considered for the 1990s as well.

Many of these factors are likely to have offsetting effects, so that the total picture is not overwhelmingly negative for price appreciation. The overall result seems most likely to be slower price appreciation for housing, particularly new houses, in which quality is likely to be high, reflecting the incomes of the "move-up" market. Resale prices will also increase overall, but at close to the rate of inflation, or just a little below that.

Rental Tenure

Rental housing is, in one very limited sense, a residual market, comprising as its consumers those who are not yet, or will never be able to be owners. While that is clearly an overstatement, since some households prefer rentals, and there are luxury-class rental accommodations, it is not an unfair assessment of much of the market. For, in stark contrast to homeowning households, renter households are generally younger and have much lower incomes: the median income for renter households is less than 60 percent of that of owners. While a significant part of that discrepancy can be explained by disproportionate numbers of single-person renters, the majority of them young, income differences remain significant for every age group and household type, and are greatest for house-

holds in their thirties, forties, and fifties.[9] Furthermore, if the post-World-War-II patterns hold, most young renters will become owners as they mature, if they do not remain poor.[10]

The demographic changes in the 1990s are thus less positive for rental housing than for ownership markets. For, to the extent that the ownership rate rises, this is apt to have a "skimming" effect on renter incomes, leaving behind mainly lower income households, as opposed to simply young ones. Added to this in the 1990s is the dearth of younger households who comprise the bulk of rental tenants, and the lack of much moving down on the part of recent retirees until the next century.

TABLE 3. Selected Rental Vacancy Rates: 1990–II

Total	7.0
Region	
Northeast	6.4
Midwest	6.0
South	8.4
West	6.4
Rent Class	
Less than $100	1.7
$100 to $199	6.0
$200 to $249	9.6
$250 to $299	9.0
$300 to $399	6.6
$400 to $499	5.4
$500 to $599	6.3
$600 to $699	5.9
$700 to $799	6.3
$800 and up	9.4

SOURCE: U.S. Department of Commerce, Bureau of the Census.

In light of this, the most negative single factor for rental markets at the beginning of the 1990s is that they are already soft. Vacancy rates rose in the late 1980s to levels not seen since the 1960s and, while they have declined somewhat recently, vacancies are still high by historical standards. Vacancies at mid-year 1990 were at or above six percent in all regions of the country, for all rent levels except the very lowest and a narrow mid-market slice, and for all sizes of units except the very largest (Table 3). Data on economic vacancies confirm the market slack.[11] The gap between actual and potential rent, expressed as a percent of potential revenue was above six percent for all measured metropolitan areas in 1989, and by region ranged from about nine percent for the Northeast, to over seven percent in the West.

That the demographic trends to 2000 are unlikely to place much economic pressure on rental markets may open an unusual oppor-

[9] U.S. Department of Commerce, Bureau of the Census. *American Housing Survey: 1987.* Washington, 1988.

[10] Chambers and Douglas Diamond, Who Never Becomes a Homeowner? *Housing Finance Review* 1988.

[11] Data on vacancies are reported by the National Apartment Association and are published in the *Survey of Income and Expenses in Rental Apartment Communities.* The data are a measure of income not realized due to vacancies over a full year and give an indication of economic pressure to expand (if rates are low) or hold steady the rental stock.

tunity in the 1990s for addressing the problems of housing affordability for lower income households. The greatest single "housing problem" in recent years has been the cost burden faced by renters who are otherwise adequately housed. In 1987, 36.7 percent of all rental households living in otherwise adequate units paid more than 30 percent of their incomes for rent, compared to 11.3 percent who lived in physically deficient units (many of whom also were rent-burdened). Among very low-income households (with incomes 50 percent or less of median), 60.2 percent had excessive rent burdens as their only housing problem. The current main Federal housing program acts as an income supplement to be used in the existing stock of rentals, and the rent levels allowed under the program are generally in a range where physical vacancies are not low. [12] Expanded use of this subsidy coupled with recent legislated increases in the earned income tax credit, or other means of effectively raising incomes for poor households, could aid rent-burdened households considerably, while having little effect on rent levels.

MOBILITY CONSIDERATIONS

Demographic changes in the 1990s suggest declining mobility, although the decline may be slight. This, in turn, would imply less need for vacancies to accommodate mobility, further reinforcing the outlook for less construction. In general, the older the population, the more married, the more two-earner families, and the greater the rate of homeownership, the less likely households are to move. Data from the American Housing Survey of 1987 on characteristics of recent movers bear this out. For example, the move rate for nonelderly renters (under age 65) was 23 percent in that year, but only 11 percent for nonelderly home owners; at the same time, the move rate for elderly renters was under 5 percent, and only about 2 percent for elderly owners. Other surveys have indicated that most households of later middle age are unlikely to move—about 86 percent over age 50 indicate no moving plans, even upon retirement—and are likely to "age in place." [13] The absolute decline in the number of households composed of more mobile young people, and the possibility of higher ownership rates overall, imply that the current vacancy rates more than accommodate the need in the absence of a change in some other factor.

CONCLUSIONS

Demographic changes, set in place a generation ago, mean that the increase in the number of American households will be slower than in the past two decades. The most important age group, in terms of additional housing demand, will be those of middle age in their peak earnings and housing-consumption years. Assuming that past trends in living patterns continue, even if more slowly, the household makeup of the 1990s will be more diverse than in the

[12] There may be mismatches in location or size between households in need and units available. All the same, the fact that most poor households already reside in physically adequate housing and are only burdened by a lack of income means that such mismatches are irrelevant for the majority.

[13] Survey of the American Association of Retired Persons.

past, with increasing shares of single-person households and minority households.

Slower household growth suggests that there will be fewer housing starts because fewer will be needed to house the increase. This is no disaster for the overall economy: the effect of lessened housing construction will actually be less than in earlier decades. This is true simply because residential construction has not been keeping pace with other sectors over time, nor has it needed to in order to house the population (Table 4). It is possible to view the 1990s as a period in which the Nation will be able to allocate housing resources to other forms of investment.

TABLE 4. Residential Investment in the Economy

	Residential Investment as a Percent of	
	Gross National Product	Gross Private Domestic Investment
1989	4.54	24.25
1985	4.82	27.37
1980	4.30	26.90
1975	4.26	29.98
1970	4.52	28.65
1965	5.47	31.12
1960	5.60	35.82
1955	6.18	35.57
1950	7.20	36.90

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis

The result of the middle-aging of the population is apt to be a higher homeownership rate because of the high propensity of the middle-aged to own, and the dearth of young households not as likely to be owners. New construction will probably concentrate on higher-quality units for middle-aged households in their peak earnings years, while markets for "entry housing" are likely to shrink. Mobility, also a function of age and homeownership, is apt to decline, slightly reinforcing the lowered pressures on housing construction.

A major difficulty of the 1980s is apt to remain—the lack of income to afford standard housing, using a reasonable proportion of income for rent, by lower-income renters. The demographic changes of the 1990s, coupled with relatively high vacancies initially, imply that an unusual window of opportunity is open: it may be possible to aid poor households through income supplements to be used in the existing stock of rental units without much pressure on rents.

VI. PRIVATE NONRESIDENTIAL CONSTRUCTION

by William A. Cox *

Private nonresidential construction accounts consistently for 30 to 35 percent of total construction in the United States, according to Census Bureau data on the inflation-adjusted value of new construction put in place. It includes office and commercial building, industrial construction and private utilities as well as private hospitals, schools, and other buildings. Its annual value is normally somewhat less than that of housing construction, which constitutes between one-third and half of the total, and somewhat more than public construction. Private nonresidential construction experiences cyclical fluctuations but not nearly such large ups and downs as homebuilding.

The major components of private nonresidential construction have followed different courses since the 1960s. (See Figure 1) The only long-term increase in real terms (i.e., excluding inflation) has been in office and commercial construction, which also accounts for most of the cyclical fluctuations in nonresidential building. [1] Construction for private utilities, principally electric power and telecommunications utilities, was nearly equal to office and commercial building in the mid-1970s but leveled off until 1982 and then entered a prolonged downturn, while office and commercial building rose substantially. Industrial building recovered in the late 1970s from a prolonged slump earlier in the decade, although it never regained the peak levels of the mid-1960s. After a relatively strong performance from 1978 through 1982, it plunged into a recession in 1983 from which it has never recovered. Nonresidential construction on farms peaked in 1978 and has slipped since 1982 to levels below those of 20 years earlier. In summary, while office and commercial construction has increased over time and soared in the 1980s, industrial construction in the broad sense—including utilities and agriculture—peaked in the 1970s and early 1980s and has declined consistently since then. Total private nonresidential construction in 1989 was barely higher in real terms than 16 years earlier in 1973.

This analysis concludes that the pattern of the 1980s is likely to be reversed in the 1990s. Office and commercial construction faces a prolonged downturn while today's extremely high vacancy rates, now above 15 percent in most cities, come down. It probably will emerge from its present crisis into an economy no longer capable,

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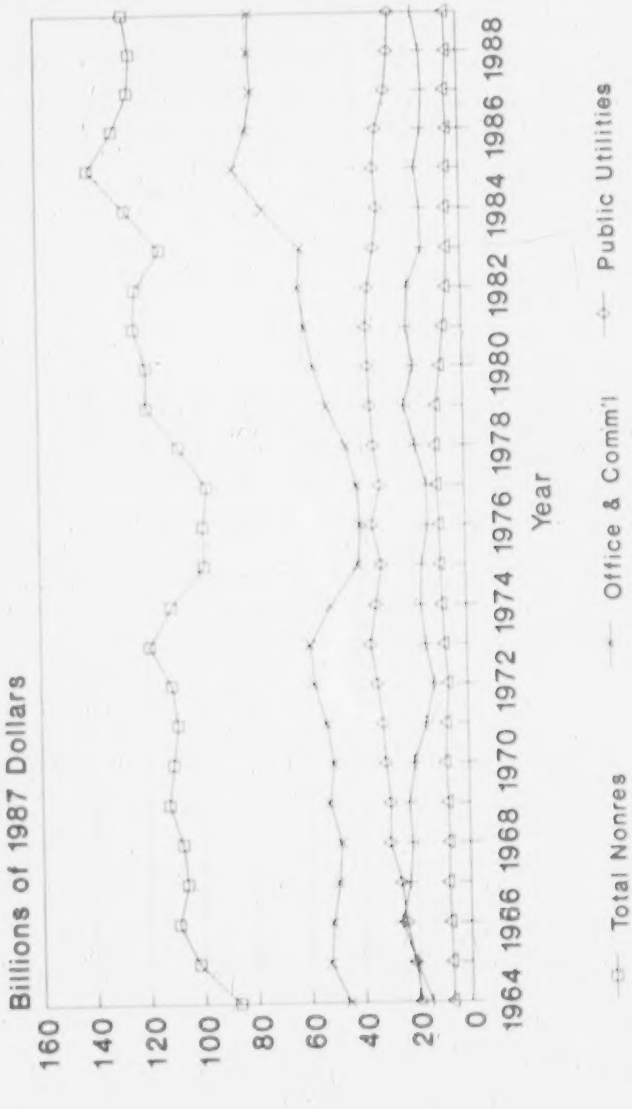
* Senior specialist in economic policy, Congressional Research Service, Library of Congress.

[1] Figure 1 shows office and commercial construction combined with hotel and motel construction and private institutional buildings such as hospitals, schools and churches. Combining these categories does not much alter either the long-term trend or the fluctuations of office and commercial construction.

because of labor scarcity, of growing as fast as it has in the past. Rising construction by manufacturers and utilities, which was depressed in the 1980s, is expected temporarily to offset much of this downturn. In the longer run, however, nonresidential construction as a whole is likely to decline to levels consistent with the long-term needs of a slowly growing population.

FIGURE 1. MAJOR COMPONENTS OF NONRESIDENTIAL CONSTRUCTION, 1964-89



Source: Bureau of the Census

This section first reviews in greater detail the development of major categories of nonresidential construction since the 1960s and some reasons for these divergent patterns. It then examines the resulting stock of business structures in the context of the need for space for production, storage, and sales. Attention then turns to special factors that helped to precipitate the fluctuations of office and commercial building in the 1980s and, finally, to prospects for

the 1990s, when the economy's growth is likely to be markedly slower than in earlier postwar decades.

Office and Commercial Building

Included with office and commercial construction, in addition to office buildings, shopping centers and malls, are hotels, motels and private institutional buildings such as schools, hospitals and churches. As shown in Figure 2, construction of such buildings rose by nearly 30 percent from 1964 to the cyclical peak in 1973 and, after a three-year recession and gradual recovery, surpassed that peak only slightly by 1982. It barely paused for the twin recessions of the early 1980s, however, and soared by 41 percent from its dip in 1983 to its peak of 1985. It then retraced about one-quarter of this gain and stabilized at that high level in the late 1980s.

The fluctuations in the 1980s, as shown in Figure 2, derive mainly from the simultaneous rise in office and other commercial building from 1983 to 1985, and the subsequent slump in office building (see the truncated lines in Figure 2).[2] Hotel and motel construction followed a similar pattern on a smaller scale.[3]

The surge of 1983-85 reflected a recovering economy and a steep decline in interest rates after several years of harsh disinflationary monetary policies in 1979 and the early 1980s. Generous depreciation allowances enacted as part of the tax reduction of 1981 gave highly leveraged real-estate investors an exceptional stimulus, and deregulation of thrift institutions in the 1980s encouraged lenders to compete vigorously to make nonresidential loans. The decline in office construction since 1986 reflected the collapse of the energy boom in the Southwest as well as overbuilding in other regions and limitations on real-estate tax shelters in the Tax Reform Act of 1986. Nonetheless, the country nearly doubled its supply of office space in 10 years. Other commercial building continued apace into 1989. (For more detail, see p. 118 f. below.)

Overbuilding was so pervasive that vacancy rates in office and commercial buildings soared from an average of 4 percent in 1981 to more than 16 percent in 1986 and remained in 1990 at that high level. Most metropolitan areas have double-digit vacancy rates. Prior to the 1990-91 recession, the highest vacancy rates were in the Southwest. Vacancies in the Northeast have risen fast, in part because of the frenzy of building begun earlier that is still coming to completion and, since the middle of 1988, because of the slowdown of economic growth and subsequent recession.

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[2] Data were not published separately for these two categories prior to 1972. The category designated "other commmercial buildings" includes shopping centers, warehouses, parking garages, banks, fast-food restaurants and gas stations. Shopping centers have accounted in recent years for about half of the value of construction in this category, and warehouses for about one-quarter. See U.S. Department of Commerce, International Trade Administration, *Construction Review*, November-December, various years.

[3] Other nonresidential building—mainly hospitals, schools and churches—was severely depressed in the mid-1970s, bottomed out in 1979, rose in the 1980s, but still fell short in real terms of 20 years earlier. So as not to create a confusing clutter, this category of construction is not shown in Figure 2.

FIGURE 2. PATTERNS OF COMMERCIAL CONSTRUCTION, 1964-1989

Source: Bureau of the Census

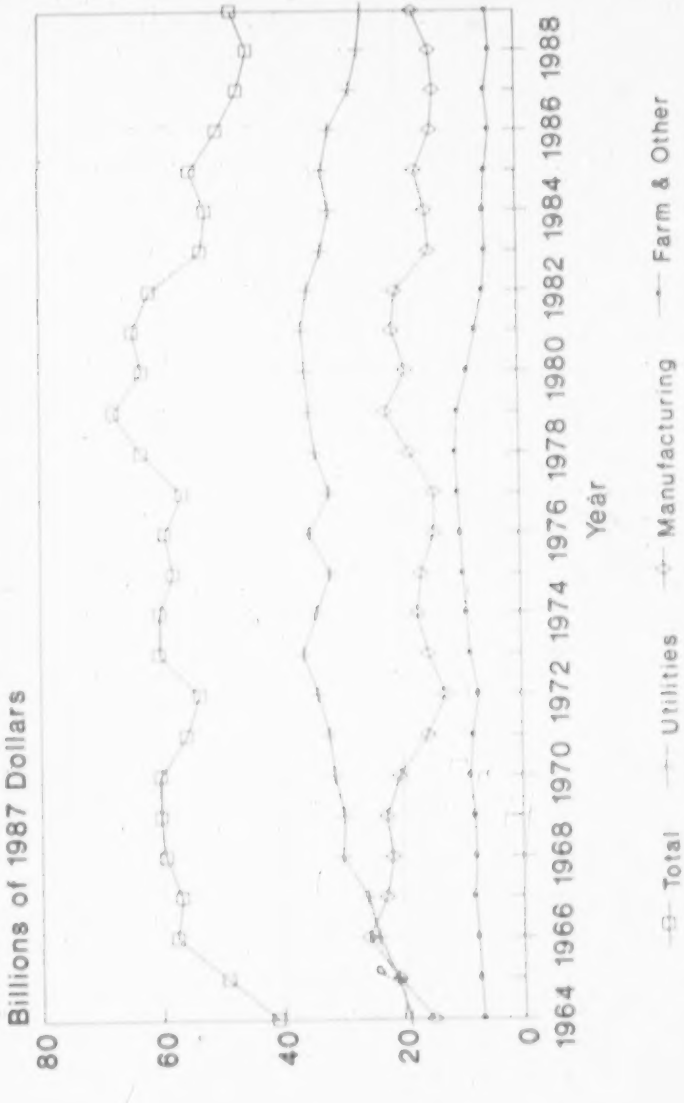
Industrial Construction

Industrial construction as defined here includes private utilities, manufacturing plants and agricultural construction. Total activity reached an all-time peak in 1979. (See Figure 3) More than half of this construction was by the utilities. A precipitous decline followed in 1983, as the twin recessions of the early 1980s took their toll. [4]

[4] Unlike residential construction, which normally declines about six months in advance of a recession in GNP and recovers with it, commercial and industrial construction normally comes to its peak after the national economy has gone into recession and weakens as it is recovering. In other words business construction lags the national business cycle.

Instead of recovering during the long economic expansion of the 1980s, industrial construction, in a startling turn, slid steeply further between 1985 and 1988 to a level only modestly above that of 24 years earlier (see Figure 3)! This remarkable decline reflected drops in all three major categories of industrial construction.

FIGURE 3. PATTERNS OF INDUSTRIAL CONSTRUCTION, 1964-1989



Source: Bureau of the Census

Construction by the utilities, which rose until 1973 and remained near that year's level through 1981, slipped thereafter and fell sharply further after 1986. This decline was dominated by a drop in construction of electric-power facilities due to conservation by

power users after steep rate increases in the 1970s. Public resistance also hobbled construction of several nuclear power plants. [5]

Construction of manufacturing plants, it is remarkable to note, reached its all-time peak in real terms in 1966—nearly 25 years ago. This peak was followed by a long slide to less than half of that level by 1972. Such construction accounts for most of the business-cycle fluctuations in industrial building. After a partial recovery in the late 1970s, which continued into the early 1980s, construction by manufacturers dropped steeply in 1983 and has remained depressed ever since.

Reasons for this recent performance include the depression of manufacturing activity as a result of the overvaluation of the dollar in the mid-1980s that priced American industry out of markets at home and abroad during that period. Reduced construction stems also from a substantial long-term decline in the production capacity of various basic industries in the United States, including steel, nonferrous metals, semiconductors and machine tools, due to shrinking markets and a loss of technological and commercial advantages over foreign competitors. Reasons for this decline are legion, including raw-material depletion, the 1970s' surge in energy prices, tighter environmental protection, substitution of other materials for metals, and a proliferation of capable foreign competitors. Rates of return on equity investment in manufacturing have declined ever since the mid-1960s as well, reducing internal funding and incentives for modernization and expansion. [6]

Nonresidential construction in agriculture also peaked in 1979 and slid steadily to less than half of that year's level by the late 1980s. This decline was driven by a drop in farm income, especially in 1980 and 1983, and by reduced farm prices from 1985 through 1987, due likewise to the overvalued exchange rate.

The net result of these forces—depressed building of manufacturing and farming facilities and reduced construction of power plants and pipelines—is a level of building activity that barely maintains existing facilities in these industries. The gross stock of industrial buildings has increased by less than one percent per year since 1985. At the same time, however, vacancy rates in these buildings have risen slightly from 5 to about 6 percent. The slow growth and rising vacancy rates reflect the stagnation of manufacturing employment.

Determinants of Nonresidential Construction

The basic purposes of private nonresidential buildings are to provide working space for employees of the private sector, to shelter inventories and equipment, and to provide sales space, particularly for commercial enterprises. Fundamentally, therefore, private non-

[5] Private utilities also include oil and gas pipelines, telecommunications (mainly telephone) facilities, and railroads. Construction of pipelines subsided after 1976 and slumped further in the 1980s. Investment in telecommunications infrastructure, meanwhile, rose fairly steadily even in the 1980s due to deregulation of the telephone industry and vigorous growth of demand. Investment in railroads, a small factor, fluctuated moderately. Construction by all utilities other than electric-power companies has shown a gradually rising trend, led by telecommunications.

[6] Library of Congress, Congressional Research Service, *Domestic Profits of U.S. Corporations, 1968–1988*, (CRS Report No. 90–278 RCO) by Marc E. Smyrek and William A. Cox, June 1990, 61 pp.

residential buildings are erected in response to growth in private employment, inventories and sales. To the extent that demographic change augurs slower growth of employment, sales and inventories, it also means slower long-term growth in the need for space and in construction to provide it. In the short term the pace of such construction is influenced also by cyclical changes in economic growth and by changes in interest rates, tax provisions and, in the memorable words of John Maynard Keynes, by the "animal spirits" of investors.

How is the total supply of such space related to current construction activity and the Census Bureau's data on the value of new construction put in place that were discussed above? People in the Commerce Department's Bureau of Economic Analysis make certain adjustments to the Census Bureau's numbers (for instance, to exclude interest on construction loans) in estimating business investment in structures. They then sum these estimates over the years and deduct estimates of the value of buildings demolished or abandoned each year to obtain a measure of the gross stock of private nonresidential structures available. When converted to constant dollars (to remove the effect of inflation), the gross stock is a gauge of the amount and quality of privately owned industrial and commercial space for use in the United States. Then each year's depreciation of the remaining structures is deducted to arrive at the net stock of structures—a gauge of available space adjusted to reflect changes in its average age and serviceability. Thus the annual value of new construction put in place is the starting point for calculating each year's change in privately owned space available.

The data as compiled by the Bureau of Economic Analysis include the investment by utility companies in distribution systems for electric power, telecommunications, and oil and natural gas, which does not fit well under the description of space available for business. They also encompass the costs of drilling oil wells and of excavations for extraction of other minerals. Agriculture, mineral extraction, and utilities with overland (and/or undersea) distribution facilities, therefore, are excluded from the data presented below. The remainder is considered the best available gauge of the stock of nonfarm business structures to shelter work force, equipment, inventories and customers.

Figure 4 shows the relationships between the annual investment in such business structures in constant dollars and resulting changes in the gross and net stock of such structures. One can appreciate the size of the exclusions described above by comparing the level of new building shown here to total nonresidential construction in Figure 1 (p. 108 above). While the pattern of development is very similar in the two figures, the level of new building in Figure 4 is $39 billion lower for 1964, $54 billion less in 1976, and $45 billion lower in 1989. Thus the significance of construction that was excluded, especially that of electric utilities and the oil and gas drilling industry, was considerable.[7] The remainder is somewhat

[7] The Census Bureau in 1990 issued revised data on construction put in place since 1964 that included several billion dollars' worth of construction for each year that previously had been

Continued

FIGURE 4. GROSS INVESTMENT IN STRUCTURES AND CHANGES IN THE CAPITAL STOCK

Excluding farming, mining & utilities

Source: Department of Commerce

more volatile than the total because construction of power plants and oil and gas wells and pipelines partially offset fluctuations in other sectors, rising in the mid-1970s and declining through most of the 1980s.

The difference between the top and middle lines in the figure indicates the value of each year's demolitions and abandonments. The pattern of such scrappage is shown separately in Figure 5.

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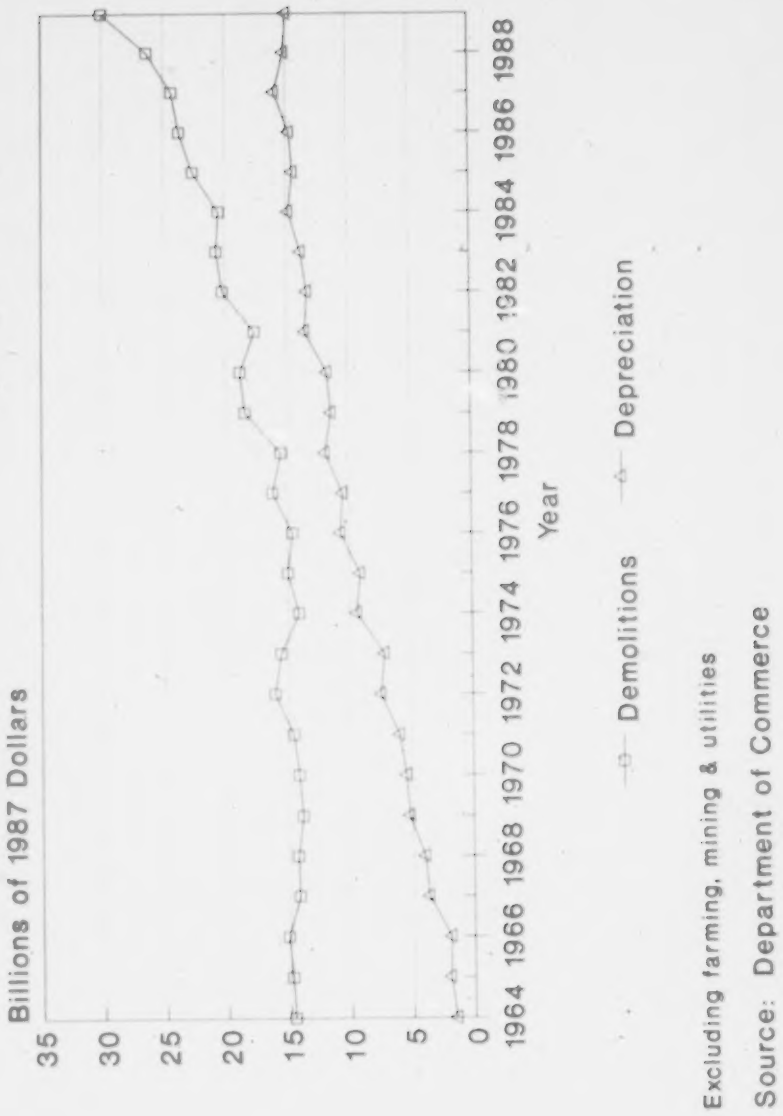
overlooked. The Bureau of Economic Analysis has not yet incorporated these revisions in its data on the annual investment in structures and the resulting capital stock. Such a revision, to be conducted in 1991, will increase these figures also by amounts in the range of $3 billion to $7 billion.

FIGURE 5. DEMOLITIONS AND DEPRECIATION OF PRIVATE NONRESIDENTIAL STRUCTURES

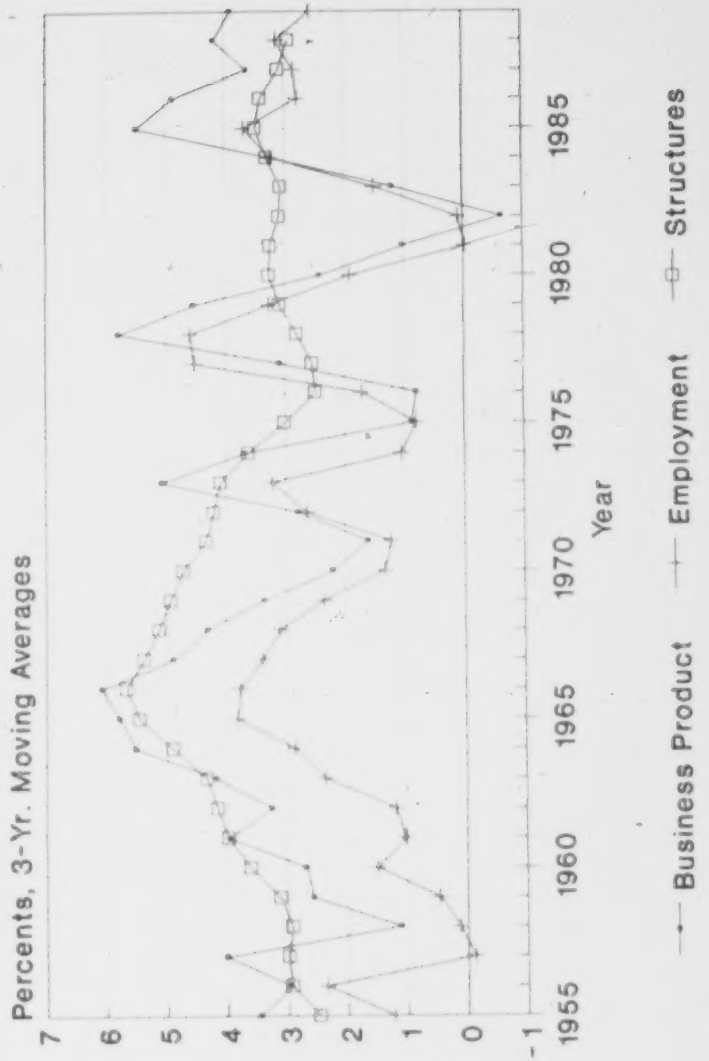


Excluding farming, mining & utilities

Source: Department of Commerce

After remaining roughly constant through 1978 at about $15 billion per year, it rose dramatically in the 1980s to reach $30 billion in 1989. The initial rise during the recessions and tight money of the early 1980s turned into a wave of demolitions and renewal with the building boom later in the decade. Because soaring construction created a glut of space, vacancies soared, and real-estate tax shelters then were limited, many old facilities were no longer profitable to keep in service. Depreciation of private nonresidential structures—the difference between the second and third lines in Figure 4—also is shown in Figure 5. After rising fairly steadily for many years at an average rate of about $0.6 billion per year, depreciation

FIGURE 6. GROWTH OF NONFARM EMPLOYMENT, BUSINESS PRODUCT & GROSS STRUCTURES



Sources: Departments of Commerce & Labor

has subsided slightly since 1987, perhaps as a result of faster scrappage and the downturn in new building. [8]

Changes in the stock of nonfarm business structures can be compared to changes in private nonfarm production and employment only after converting them all to relative (i.e., percentage) terms. Figure 6 compares annual percentage changes since 1955 in the gross stock of such structures, which represents privately owned space available, with percent changes in private nonfarm payroll employment and gross private domestic nonfarm product. Private

[8] Depreciation can be estimated using different formulas. As shown here it is calculated using a so-called "beta decay function," which attributes relatively little depreciation to the first few years of an asset's life with rapidly rising depreciation later on. This pattern is thought to represent best the actual decline in the efficiency of capital.

nonfarm product includes not only industrial production but also value added in wholesaling, retailing and provision of services, excluding government services. Because all three of these series, especially output and employment, exhibit considerable year-to-year volatility, three-year moving averages of their rates of change are used to compare the directions of change without the distraction of large annual fluctuations. [9] Because changes in production lead the other two variables by a year, production is lagged by one year in Figure 6. [10]

As one sees in the figure, when growth rates of output and employment were rising, growth of the stock of buildings also tended to rise; the two likewise tended to fall together. The short-lived economic recovery of 1972–73, when space additions continued downward, was an exception. The growth of production and employment is considerably more volatile than that of the stock of structures, because of the long-term commitment involved in erecting a building and the long time required between the impetus to build and completion of construction. This difference appears to have been accentuated in the 1980s, however, as a halt in (three-year-average) growth rates of production and employment in 1981 and 1982 were barely reflected in a slight dip in growth of building stock, which continued at more than 3 percent. The business recovery likewise had little impact on the rate of space expansion.

As indicated in Table 1 below, the compound annual growth rate of nonfarm business product from 1955 to 1989 was 3.2 percent; private nonfarm employment grew by 2.2 percent per year. Growth of output exceeded the rise in employment over this 34-year period by a one-percent average annual increase in labor productivity. The gross stock of private nonresidential structures (excluding utilities, farms and extractive industries) expanded meanwhile by 3.6 percent per year. This indicates that the amount and/or the quality of indoor space per employee has risen substantially, while space utilization per unit of production also has risen somewhat.

TABLE 1. Compound Annual Growth Rates of Private Employment, Production, and Stock of Structures, 1955–1989

Time Period	Production	Employment	Structures
1955–1989	3.2	2.2	3.6
1955–1974	3.4	2.0	4.2
1974–1989	3.0	2.3	3.0

NOTE: Employment includes full and part-time wage and salary workers in nonagricultural establishments, excluding government. Production refers to gross domestic business product.

SOURCES: U.S. Departments of Commerce and Labor.

It is clear from Figure 6, however, that most of the increase in building stock per dollar of production and, in fact, all of the increase in building stock per employee occurred in the earlier part of the period; that is, before 1974. As indicated in the table, in-

[9] The three-year moving averages encompass values for the year in question, the previous year and the subsequent year.

[10] This means that the percent change in the three-year average level of production for 1970, compared to 1969, is plotted as the 1971 observation in the figure, and likewise for other years.

creases in the building stock were nearly one-fourth larger than increases in output during that period and more than twice the increase in employment. This was the boom time of postwar renewal and expansion, following a prolonged period of suppressed investment during the Great Depression and World War II.

The oil embargo and energy prices increases of 1974 were a watershed in many ways, including in world economic development. The abrupt decline in productivity growth, indicated in Figure 6 by the narrower distance between production and employment growth after 1974, [11] was accompanied by an abrupt slackening of the increase in business structures relative to these other two variables. Expansion and upgrading of the stock of structures suddenly slowed to equal the average increase in output during the more recent period (see Table 1). They exceeded increases in employment by less than one-third.

This is true despite the well known excesses in office and commercial building in the 1980s. Part of the explanation for the restrained growth in the stock of structures, despite record construction activity, was the rapid rise in demolitions and abandonments of business property during this period. Vacancy rates in office and commercial building, nonetheless, went soaring to levels that exceeded 15 percent after 1985.

Special Factors Affecting Construction in the 1980s

Critical to explaining the fluctuations of office and commercial construction in this period were unprecedented changes in tax policy together with unprecedented changes in lending practices. The Economic Recovery Tax Act of 1981, requested by President Reagan at the outset of his first term of office and promptly passed by Congress, reduced effective tax rates on income from investment in buildings by greatly accelerating depreciation allowances. Depreciation periods for tax purposes were reduced from an average of about 35 years to 15 years, and the method of calculating depreciation was made more favorable. This permitted costs of owning such buildings to be greatly overstated when calculating taxable incomes.

If an investment is financed partly by borrowing, then part of the return—the part used to cover interest payments—is treated under the tax code as a business expense to the borrower, not as taxable income. In this case, the accelerated (i.e. exaggerated) allowance for depreciation cost can be charged against the remainder of the return, which goes to the owners. This often permitted assets that were readily financed by borrowing, such as real estate, to yield "losses" for the owners' tax accounts while yielding profits in fact.

The fictitious "losses" thereby generated for owners, especially when purchasing properties with large shares of borrowed money, could shelter from taxation substantial income from other sources. Thus real-estate tax shelters, which had been popular even before the 1981 tax cuts, became much more profitable after those

[11] Indeed the growth of employment *exceeded* that of output in 1976 and 1977 and again in 1982 and 1983—all years of recession or recovery, when unemployment was very high.

changes. As shown in Figure 2 (p. 110 above), construction of office buildings hardly paused in the deep recessions of the early 1980s as it extended its rise of the late 1970s to a pinnacle in 1985. Commercial construction also boomed in 1984 and 1985. [12]

Another contributor to overbuilding, according to many analysts, was a concatenation of circumstances that channeled large-scale loan financing into commercial real estate on easier terms than before. The Garn-St Germain Act of 1982 permitted saving-and-loan associations greatly to expand their lending for commercial real estate, and they went headlong into it. In competition with them, commercial banks substantially increased the fraction of their lending to real-estate purchasers and developers, as some of their large corporate customers turned away from them to borrow in securities markets. Insurance companies, pension funds, foreign investors and others joined in, creating a speculative bubble in office and other commercial buildings, despite soaring vacancy rates. Even though new lending was scaled back after curtailment of real-estate tax shelters in 1986, project completions continued apace. [13]

The Tax Reform Act of 1986 eliminated most use of real-estate investments as tax shelters. Its so-called "passive-loss limitation" excluded tax losses for investors not actively involved in managing a property. Depreciation accounting also was made less favorable. [14]

Nonetheless, the 1980s were witness to a massive wave of overbuilding. According to Robert Samuelson,

> In the 50 largest metropolitan areas, office space more than doubled. The number of shopping centers rose 57 percent . . . and their retail floor space increased 42 percent. . . . Hotel rooms jumped 43 percent. . . . Meanwhile, population expanded 8.5 percent, employment 18 percent and the gross national product 29 percent. [15]

Why did the forces that produced the boom in office and commercial construction fail to create a similar boom in industrial construction? The tax breaks applied to manufacturing plants just as to office buildings. The answer must lie in the much higher rate of profitability and hence higher rate of growth in service industries than in manufacturing. [16] Slower gains in labor productivity in service industries, moreover, mean that employment growth more nearly matched output growth, while employment in manufacturing has leveled off, despite output growth, due to faster advances in

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[12] Taxes on the construction industry itself, moreover, were almost eliminated by the tax act of 1981 because of rapid depreciation plus the tax credit for investments in business equipment, which constitutes most of the capital of that industry. Even though these tax preferences were scaled back somewhat in 1982, construction remained—after oil extraction—among the most lightly taxed major industries.

[13] Robert J. Samuelson, The Great Real Estate Bust, *The Washington Post*, October 4, 1990, A27.

[14] By abolishing the tax credit for investment in business equipment and reforming depreciation, the Act also raised taxes on the construction industry to levels comparable with other industries. See Library of Congress, Congressional Research Service, *Effective Corporate Tax Rates and Tax Changes in the 97th Congress*, by Jane G. Gravelle, January 3, 1983, 12 p. Also *Effective Corporate Tax Rates in the Major Tax Revision Plans: A Comparison of the House, Senate, and Conference Committee Versions*, (CRS Report No. 86-854 E), by Jane G. Gravelle, August, 1986, 4 p.

[15] Samuelson, op. cit.

[16] Library of Congress, Congressional Research Service, *Domestic Profits of U.S. Corporations, 1968-1988* (Report No. 90-278 RCO) by Marc E. Smyrl and William A. Cox.

productivity. Utilities are a special case, of course, which was dominated in the 1980s by sluggish growth of demand for electric power.

Nonresidential Construction in the 1990s

Changes are taking place in factors determining economic growth that will have decisive long-term influences on nonresidential construction, just as they will on housing. Not only does office and commercial construction face a prolonged depression while today's high vacancy rates come down to reasonable levels, but it will emerge from the present crisis to find an economy that no longer is capable of growing as fast on a sustained basis as it did in the past. Employment growth will be permanently slower because of much reduced labor-force growth, so that office and commercial construction may never return to levels reached in the 1980s. Rising construction by manufacturers and utilities, however, is expected to take up much of the slack in the 1990s.

As outlined in Section III above, the U.S. labor force grew in the 1980s by 1.6 percent per year in contrast to 2.6 percent in the 1970s. Mainly because of a further decline in the number of young people entering the job market, the labor force is projected to expand between 1988 and 2000 at a still slower rate of 1.2 percent per year. Because unemployment had been reduced by 1989 to nearly the minimum level consistent with stable inflation, employment in the 1990s, unlike the 1980s, will not be able to grow much faster than the labor force.

In light of these forecasts, the U.S. Department of Labor, assisted by Data Resources, Incorporated, projected that real GNP will grow at a compound annual rate of 2.3 percent from 1988 to 2000. This contrasts to a growth rate of 2.9 percent for 1976 to 1988, the previous period of equal length. [17]

Employment growth is projected to slow by a whole percentage point per year and to match the growth of the labor force itself at an average of 1.2 percent. Nearly half of this slowdown, however, would be offset by a rise in the growth of labor productivity. Productivity growth is projected to accelerate both because today's aging labor force is becoming more mature and because capital-to-labor ratios in production are projected to rise faster as a result of labor scarcity. [18]

Consistent with this projection is slower growth in construction of nonresidential buildings, excluding the special case of the utilities. This is true even after allowing for some increase in construction of manufacturing plants and farm structures due to a projected long-term improvement in the balance of international trade. Construction of nonresidential buildings excluding utilities is projected by the Department of Labor (DOL) to rise at an annual rate of 2.3 percent from 1988 to 2000, down from 3.5 percent in the pre-

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[17] Saunders, Norman C. The aggregate structure of the economy. *Monthly Labor Review*, November 1989, p. 13 f. See especially p. 14, Table 1. These projections were generated using a model of the U.S. economy developed by Data Resources, Incorporated (DRI). They will be referred to hereafter as the DOL/DRI projections.

[18] Ibid. See especially p. 22.

vious 12 years, a drop by one-third in the rate of growth. This is generally consistent with the patterns shown in Table 1 above. [19]

This slowdown in growth of nonresidential building is projected to be partly offset by increases in construction by the utilities. The long decline in construction of electric power plants and distribution facilities will have to turn around in the early 1990s, because demand for electricity in many areas is finally reaching full usage of the generating capacity erected in the 1970s. Construction of oil and natural gas pipelines also could revive if world petroleum prices move upward in the 1990s.

The DOL/DRI projection is that construction of electric power facilities, which has fallen into a depression since 1982, will move back up toward its earlier level by the year 2000. In these estimates, this turn-around would virtually offset the slower growth in building of other private nonresidential facilities between 1988 and 2000. The net result would be a continuation of 2-percent annual growth in construction of private buildings and utility installations combined.

These projections may be too high, however. DOL and DRI projected that vacancy rates in office and other commercial buildings would begin to decline in 1989 and that excess capacity in this sector would be eliminated by the early 1990s. It projected a "modest recovery" for commercial construction after 1993. [20] But vacancy rates did not decline in 1989, as newly completed buildings continued to come on stream, and recession in 1990 and 1991 set the recovery process back by at least two additional years.

One banker, who preferred anonymity, has been quoted as saying, "In five years we've built a 15-year supply of space, and we're going to spend the next 10 years trying to fill it." [21] According to another analyst, "Absorption of office space is at an all-time low." Developers did not see the demographic slowdown coming or, if they saw it, chose to believe it would not apply to them. [22]

Hence the slowdown in office and commercial construction may be more severe and longer-lasting than the DOL/DRI projections indicate. A senior economist for a major bank analyzed the situation this way:

> Since 1985 . . . space in commercial buildings has been increasing at a 4½ percent annual rate . . . Recall that the economy has been growing about 4 percent per year during much of the 1980s . . . and still the vacancy rate is stuck at over 16 percent. And now GNP growth has slipped, most likely permanently, into a 2-percent pace . . .
>
> The last major contraction in commercial construction occurred in the early to mid-1970s. At that time, the level of commercial construction declined about one-third from earlier years. Should that occur again, it would lower the increase in space from about 4 percent recently to about 2¼ percent. While service employment will be increasing at a more rapid rate than manufacturing, the differential will not be wide enough to bring the vacancy rate to less than 10 percent in less than 5 years. Most likely the decline in construction will have to be larger.

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[19] The rate cited here for 1976 to 1988 is higher than the 3.0-percent rate shown in Table 1 for 1974 to 1989, because construction declined from 1974 to 1976 as a result of general recession. The base level for this calculation, therefore, is lower than for the one reported in the table.

[20] Ibid., p. 20.

[21] Robert Guenther, The Outlook: Real Estate's Ills Are Likely to Linger, *The Wall Street Journal*, September 24, 1990, p. A1.

[22] Ibid.

> If commercial construction were to drop by half, the growth rate of space would shrink to slightly over 1 percent. At this level of construction, the vacancy rate could decline to under 10 percent in about 3 years. As is clear, the magnitude of the structural adjustment is large, and more of the adjustment lies ahead than behind. [23]

A yet more alarmist view was expressed in another recent study, which contended that office building in the 1990s may be as much as 90 percent below levels of the 1980s. According to a press report,

> If economic conditions are very favorable—if immigration is high, new technologies create dramatic job growth or elderly people remain in the work force longer—the need for newly built office space may fall only 65 percent in the 1990s from the 1980s. . . . But if more conservative assumptions hold true, demand for office construction could fall by 90 percent. [24]

It must be borne in mind, however, that these concerns apply only to office and commercial building, which in 1989 constituted 62 percent of private nonresidential construction but only about 20 percent of total U.S. construction, which is dominated by homebuilding and includes public construction. Before the boom of the mid-1980s, office and commercial building was less than half of private nonresidential construction and about 17 percent of the overall total.

If office and commercial building falls by half for three years, as suggested by one of the more cautious observers quoted above, it clearly will impose hardship on construction contractors, building tradesmen, and building-materials suppliers as well as on real estate brokers, lenders, and others. Combined with the prospect of sluggish homebuilding, it could make a recovery from the 1990–91 recession weak and long in coming.

Finally it should be recognized that even the expected rebound in building for utilities and manufacturing companies is likely to be a transitory phenomenon that could maintain the growth of total building activity for a decade or so but ultimately may decline again as the catch-up needs of the 1990s are satisfied. In the long run, unless population growth accelerates substantially again, the demographic slowdown will be reflected in overall building activity.

Proposals doubtless will be made to restore tax preferences for construction and real estate investors to help revive real estate property prices, banks' loan portfolios and building activity. In considering such proposals, one should bear in mind that principal purposes of the Tax Reform Act of 1986 were to reduce the number of tax preferences, which lose revenue, vitiate each other's incentive effects, and tend to debase the fairness of the tax system; and to move toward lower tax rates and neutrality among asset types in taxing capital income. An important preference for investments in business equipment—the so-called investment tax credit—also was eliminated. These steps toward neutrality enhance the efficiency of investment by increasing the role of market incentives relative to tax incentives in determining its allocation.

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[23] Based on an unpublished analysis done in May 1990 and made available by a senior economist of a major U.S. bank.

[24] Study: U.S. Office Construction May Fall 90 Percent in the 1990s, *The Washington Post*, October 19, 1990, p. F1. The article describes a study commissioned by the National Association of Industrial and Office Parks (NAIOP) and carried out by researchers at the Massachusetts Institute of Technology and Cognetics, Incorporated, both of Cambridge, Massachusetts.

Economists historically have contended that tax preferences do little to change the Nation's total level of investment but work primarily to shift it from one form to another. Real estate investment, nearly always financed by long-term loans, still is favored by the tax preference for debt financing. Before augmenting this preference, one must consider the excess office capacity (i.e. waste) created in the 1980s and ask whether spurring this use of investment resources at the expense of others is in the Nation's interest.

Nevertheless, if the economy remains weak for an extended period of time, the idea of stimulating the construction industry through the tax code or other means, such as public works, is likely to gain support.

VII. DEMOGRAPHIC TRENDS AND TRANSPORTATION INFRASTRUCTURE

by Jeff Hornbeck *

The demand for transportation is dependent on many variables, including population, economic growth, real per capita income, and the relative price of transportation. Of these variables, demography is undergoing long-term changes that may affect the structural demand for transportation in the coming decade. The effects of slowing demographic trends on transportation demand may also have far-reaching repercussions for associated public capital investment. By anticipating population trends (size, composition, geographic distribution), extrapolations can be made of future demand for transportation services. These, in turn, may be used to estimate future capital investment needed to maintain and expand transportation infrastructure.

This report discusses the demographic forces that have helped shape current transportation systems and compares them to projected population trends through the turn of the century. The effect of changing demography on transportation infrastructure is then addressed. Although some discussion of future levels of public capital investment is included, the array of complex and controversial "needs assessments" that exist is not treated.

Background: National and Regional Demographic Trends

The Bureau of the Census provides baseline projections of population growth and its age-sex geographical distribution given assumptions regarding fertility, mortality, net immigration, and internal migration. Perhaps the most notable national trends are the dramatic slowdown in population growth, the aging of American population, and the shift in population growth (including immigration) from the Northeast and Midwest to the South and West.

From a national perspective, all demographic variables will grow at a much slower rate in the 1990s than they have in previous decades. As demonstrated in Table 1, population, labor force, and household growth rates during this decade may be nearly half of what they were for the previous twenty years. These trends reflect fundamental structural changes in the Nation's population.

Although all regions are expected to experience the slowed growth of demographic variables, the effects will not be uniform. The highest population growth rates from 1990 to 2000 are expected to occur in the West (13.7 percent) and South (11.0 percent), followed at some distance by the Northeast (2.4 percent) and Midwest

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TABLE 1. Growth Rates of Selected U.S. Demographic Variables

(compound annual percentage growth)

Period	Population	>18 years	Labor Force	Households
Historical:				
1970–80	1.1	2.0	2.4	2.2
1980–90	1.0	1.3	1.6	1.6
Projected:				
1990–95	0.8	0.8	1.1	1.3
1995–00	0.6	0.9	1.3	1.1
2000–10	0.5	0.8	—	—

SOURCES: U.S. Department of Commerce, Bureau of the Census and Bureau of Labor Statistics.

(−0.3 percent).[2] The aging of the "baby-boom" generation as it reaches the 45–64 age bracket is the other significant trend for the next two decades. Although these are some of the most salient features of the Nation's population, without further analysis they provide only limited insight in predicting demand for transportation services and associated infrastructure.

In the past, transportation planners could expect population growth estimates to be direct indicators of future demand for transportation services. According to these guidelines, the above projections would indicate a distinct slowing in the demand for transportation and perhaps reduced spending needs for new infrastructure construction. These conclusions, however, are based on a direct link between demographic trends and transportation that although observed in the early part of the twentieth century, has not held in recent decades. Beginning in the 1960s divergent growth rates in job creation and households made this longstanding relationship between population growth and demand for transportation less direct. Combined with more dramatic demographic changes below the national and regional levels, transportation planners had to adjust their thinking to forecast future capacity requirements more accurately.[3]

In addition to evaluating major demographic projections, transportation planners must analyze trends that specifically affect commuting, freight movement, air travel, and other demands. Among the more important developments for surface transportation were the dramatic growth in labor force, the decentralization of metropolitan economic activity resulting from migration to suburban areas, and increases in the number of households and private automobiles. Each of these trends has contributed to highway congestion problems, the last two to declining transit use. Given that economic, population, and especially job growth are expected to slow substantially in the coming decade, past trends may or may not adequately predict effects on transportation and infrastructure.

Demand for air travel, by contrast, has been affected more by changes in aviation technology and airline deregulation, which has

[2] U.S. Department of Commerce. Bureau of the Census. *Projections of Population of States, by Age, Sex, and Race: 1988–2010*, by Signe I. Wetrogan. Series P–25, No. 1017. Washington, 1988. p. 2.

[3] Eno Foundation for Transportation, Inc. *Commuting in America: A National Report on Commuting Patterns and Trends*, by Alan E. Pisarski. Washington, 1987. p. 28.

led to reduced fares, rapid traffic growth, and capacity constraints in certain airports. Although the most congested airports are often in the largest metropolitan areas, it is not clear that demography, per se, is the factor most affecting air-travel problems. The demand to fly, governed by income and fares, has fluctuated dramatically over the last decade as the airline industry has adjusted to the deregulated business environment.

Surface Transportation and the Demographics of Work Force, Households, and Vehicle Ownership

Demand for surface transportation, primarily movement by car, truck, bus, or rail transit, is affected by demographic trends. The importance of population dynamics for transportation demand is manifested in growth trends of correlated variables such as the work force, households, and vehicle ownership. This demand leads to infrastructure investment in two distinct areas: highways and bridges, which are by far the single largest infrastructure investment in the United States, and mass transit systems, including both rail and bus networks.

TABLE 2. Population and Work Force Growth Rates, 1970–80

(in percent)

Metropolitan Area	Population Growth Rate	Work Force Growth Rate
Phoenix, AZ	55	80
Tampa-St. Pete, FL	44	66
Denver, CO	31	63
Sacramento, CA	27	48
Washington, DC	5	24
Cincinnati, OH	3	16
St. Louis, MO	−2	12
Cleveland, OH	−6	5
Buffalo, NY	−8	1

SOURCE: Eno Foundation, *Commuting in America*, p. 37.

From 1950 to 1980, the U.S. population grew by 50 percent. Growth rates peaked during the 1960s before declining steadily through the 1980s. Although all areas (rural, urban, and suburban) experienced this trend, growth rates were far from uniform. If these general population observations had been used to forecast demand for transportation they would have greatly misspecified the need for capital investment in all types of infrastructure. Other factors became better predictors of transportation demand. [4]

Labor force growth, for example, exceeded population growth from 1950 to 1980 by some 15 percentage points. This trend became more prominent after the 1960s due, by and large, to the coming of age of the baby-boom generation and increasing entrance of women into the work force. From 1970 to 1980, while total population grew by only 11 percent, the working-age group expanded by 19 percent,

[4] Eno Foundation, *Commuting In America*, p. 20 and U.S. Department of Transportation. Federal Highway Administration. *The Future National Highway Program: Changing Demographic and Economic Base*. Working Paper No. 1. October 1987. Washington, 1987. p. 3

with the younger segment of this group (16 to 34 years of age) growing by 32 percent, or nearly at three times the total population rate. The divergent growth rates in population and work force for selected cities are shown in Table 2. Their effect on local transportation systems, particularly during peak commuting hours, was paramount. Even those communities that experienced declining population had to deal with increased traffic resulting from growth in work related trips. [5]

Changing patterns of worksite and household locations also affected demand for surface transportation. [6] Since 1950, 86 percent of population growth has occurred in suburbia, affecting the largest metropolitan areas the most. Suburban growth coincided with lower growth rates in rural and center-city areas. From 1960 to 1980, the percentage of total jobs that were located in suburban areas grew from approximately one-third to one-half. Although population growth favored the southern and western portions of the country, suburbanization appears to have occurred on a relatively uniform basis throughout the country.

Changes in household formation increased demand for transportation as well. The number of households grew faster than the population (an increase of 85 percent from 1950 to 1980) partly because the number of persons per household tended to shrink. This trend continued into the 1980s; households grew by 13.9 percent from 1980 to 1988, while total population expanded by only 8.5 percent. This was due to three principal factors: a preference for smaller families, an increase in the number of single-parent families, and a rise in the number of people living alone.

The large increase in number of households caused demand for transportation (trips) to grow for two reasons. First, domestic-related trips increased because the need to procure groceries, domestic services, and other goods relates more closely to the number of households than individuals. Second, an increase in single-parent families has resulted in greater labor-force participation, generating more commuting or work-related trips. Although growth rates for all demographic variables will fall in the 1990s, the higher growth of households relative to general population is expected to continue. [7]

Perhaps more importantly, in addition to an increase in the number of households, the number of vehicles per household grew, rising by a factor of two on a per capita basis from 1960 to 1980. Measured differently, there was a 137-percent increase in the number of vehicles. By 1980, only 13 percent of all households had no vehicles and many of these did not have a full time worker. Of most significance was the increased availability of vehicles for

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[5] Eno Foundation, *Commuting in America*, p. 21. Also U.S. Department of Transportation. Federal Highway Administration. *America's Challenge for Highway Transportation in the 21st Century*. November 1988. Washington, 1988. p. 11 and 16, and FHWA, *Changing Demographic and Economic Base*, p. 17.

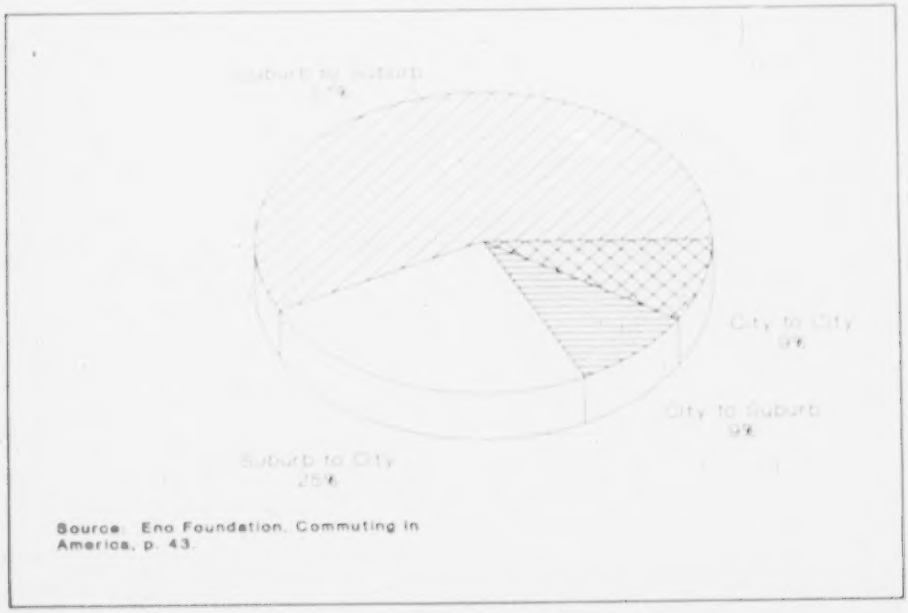
[6] Eno Foundation, *Commuting in America*, p. 24 and 40 and FHWA, *America's Challenge*, p. 19. For similar discussions of these basic demographic trends see The Urban Institute. *The Nation's Public Works: Report on Mass Transit*. Prepared for the National Council on Public Works Improvement, by Ronald F. Kirby and Arlee T. Reno. Washington, 1987. p. 5-8.

[7] Eno Foundation, *Commuting in America*, p. 33-34, FHWA, *Changing Demographic and Economic Base*, p. 10, and Bureau of the Census. *State Population and Household Estimates with Age, Sex, and Components of Change: 1981-1988*. Series P-25. No 1044. Washington, 1989. p. 1.

workers. Vehicles per worker grew from 0.85 in 1960 to 1.35 in 1980, supporting an increasing preference for driving to work individually. Combined with vast growth of workers and households, it is not surprising that metropolitan areas throughout the country have experienced congestion problems as highway traffic bumped up against capacity limitations. [8]

Capacity problems became most evident with the changing commuting patterns across the Nation. From 1960 to 1980, the number of travelers making the traditional suburb-to-city commute represented only 25 percent of commuting growth, whereas those following suburb-to-suburb commuting patterns represented 57 percent, as demonstrated in Figure 1. Similar patterns of growth were observed in all metropolitan areas but were most pronounced in those with populations between 1 and 3 million people. Changes in commuting patterns did not fit well with existing transit systems, which were not adequately servicing the higher-growth suburban areas. As a result, highways continued to become more crowded as the majority of commuters were either unable or unwilling to use public transit.

FIGURE 1. Growth in Commuter Market by Segment (1960-80)



Source: Eno Foundation, Commuting in America, p. 43.

Traffic congestion was exacerbated by fast growth in highway freight transportation as well. From 1950–80, truck traffic grew 81 percent as measured by tons of freight moved, and 133 percent if measured by the number of ton-miles traveled. Growth of imports, container traffic, and "just-in-time" inventory deliveries have all

[8] Eno Foundation, *Commuting in America*, p. 34 and U.S. General Accounting Office. *Traffic Congestion: Trends, Measures, and Effects*. Report to the Congress by the Comptroller General of the United States. GAO/PEMD-90-1, November 1989. Washington, 1989. p. 15-34.

contributed to higher levels of truck use. Should the U.S. economy continue to grow, even if at slower rates, it may be expected that freight traffic will continue to expand in the coming decade. [9]

Many of the demographic trends that caused higher travel and congestion in some areas are not expected to continue at the same high rates as in the previous twenty years. Nonetheless, real, albeit slower, growth in car ownership, freight movement, and commuter traffic will continue to test highway design capacities. Much of future infrastructure work, both new construction and maintenance, therefore is required to meet previous as well as future growth.

FUTURE TRAVEL DEMAND: CONGESTED HIGHWAYS AND BRIDGES

The Federal Highway Administration (FHWA) has constructed a simulation model to estimate future highway use and capital spending that will be needed to ensure that adequate infrastructure exists. The demand for travel includes all demographic variables discussed above as well as effects related to technology, such as gas efficiency of cars and the relative price and availability of gasoline. Expected travel demand is developed from historical data collected by the States and captured by FHWA in the national Highway Performance Monitoring System (HPMS). In addition, the HPMS provides estimates of highway deterioration given various assumptions regarding use. This model yields a range of projections regarding future demand for travel and public investment in infrastructure for nonlocal roads. [10]

The FHWA provides some additional insight into the demographic trends already discussed. For example, FHWA notes that average annual road travel per motorist increases with age until 45 and decreases thereafter until average travel at age 65 has fallen to less than one-half of that for individuals in the 40-49 year age group. [11] Given that the average age of the driving population is expected to increase into the twenty-first century because of the aging baby-boom generation, declining birth rates, and increasing life expectancies, demand for travel per capita may fall.

A number of uncertainties, however, might alter or soften this conclusion. For example, the next decade will see members of the baby-boom generation enter years of their highest productivity and earnings, perhaps increasing their propensity to travel for both work and leisure purposes. As the 65-and-older age group grows in size, its demand for leisure or discretionary travel might increase, as well. This latter group might increase demand for more specialized transportation services. In general, however, aging of the driving public is expected to increase off-peak-hour trips and thereby serve to smooth traffic flows throughout the day, perhaps creating greater efficiency in the use of road systems that are already congested. [12]

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[9] FHWA, *America's Challenge*, p. 42-45; GAO, *Traffic Congestion*, p. 26-29; and FHWA, *Changing Demographic and Economic Base*, p. 22-23.

[10] U.S. Congress. House Committee on Public Works and Transportation. *The Status of the Nation's Highways and Bridges: Conditions and Performance and Highway Bridge Replacement and Rehabilitation Program 1989*. Committee Print, 101st Congress., 1st Sess. Washington, U.S. Govt. Print. Off., 1989. p. 91-92. (Hereafter cited as House Public Works Committee, *Status*)

[11] Ibid., p. 88.

[12] FHWA, *America's Challenge*, p. 20 and *Changing Demographic and Economic Base*, p. 9.

Another trend affecting prospective increases in number of vehicles operated in the United States is that the growth in the number of licensed drivers has effectively peaked. As of 1987, 85 percent of the adult population was licensed, including 95 percent of the 25–35 year age group. Considering that these figures incorporate an absolute increase in both the number and percentage of women drivers, as well as growth associated with the baby boom, the pool of potential new drivers has shrunk to a small fraction of what it once was. [13]

These demographic trends, according to the FHWA, suggest that the annual *growth* in travel demand (in vehicle miles of travel) will decrease, which is also consistent with the broader demographic trends summarized in Table 1. Between 1966 and 1987, annual growth in travel averaged over 3.5 percent, except for years affected by recessions, particularly those involving oil shortages. FHWA expects the annual growth in travel to fall from 3.5 percent to between 2 and 3 percent through the year 2005; its preferred estimate is an average of 2.3 percent. [14] Although this might suggest that new transportation infrastructure construction may be reduced substantially from earlier high-growth periods, it still represents positive growth that will continue to require capital investment for new construction and particularly maintenance of highways.

Despite expected slower growth in travel demand, it is unlikely that the United States can afford an absolute decrease in highway and bridge spending. In addition to meeting new construction needs, maintaining structures that have already been built presents a formidable challenge for all levels of government. In fact, there is a backlog of highway and bridge needs that has accrued because all levels of government have paid insufficient attention to maintenance needs in the past.

Because all levels of government have pursued a policy of deferred maintenance, many preventive maintenance projects that at one time might have been repaired with relatively small financial commitments have now become very costly capital replacement projects. In 1988, for example, highway spending by all levels of government, including maintenance, reached $56 billion, yet pavement conditions throughout the Nation (rural and urban) did not improve noticeably from previous years. [15] Existing capital replacement needs, expected needs relating to the aging interstate system, and new construction required in many urban areas result in much higher public capital investment estimates than might be expected from looking at slower demographic and driving growth trends. [16]

FHWA's simulation model suggests a range of possible capital investment estimates for transportation infrastructure based on the variables discussed above. It should be kept in mind that any assessment of this type requires a critical assumption concerning the level of system performance that is to be achieved. The fact that

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[13] House Public Works Committee, *Status*, p. 89.
[14] Ibid., p. 91.
[15] House Public Works Committee, *Status*, p. 72.
[16] For a discussion of highway maintenance and Federal grant programs see U.S. Library of Congress, Congressional Research Service, *Maintaining Highway and Bridge Investments: What Role for Federal Grant Programs?* Report No. 90-277 E, by J. F. Hornbeck, May 31, 1990.

States use different methods to collect and analyze data may cause further problems in final interpretation.

One scenario developed by FHWA is referred to as the "constrained full needs investment strategy." It assumes that the backlogged and accruing deficiencies in the highways through 2005 would be repaired to at least "minimum standards." It further assumes that only those capacity improvements would be made that could reasonably be expected given various other physical constraints. For example, FHWA notes that congested urban areas would probably remain this way because physical space (right-of-way) limitations would prohibit them from "building their way out of peak-period congestion." [17]

Under the constrained full needs investment strategy, FHWA estimates that average annual outlays in 1987 dollars by all levels of government for capital investments in highways through 2005 would range between $29.8 and $34.5 billion (based on a range of travel demand growth of 2 to 3 percent). [18] This compares to total annual outlays for capital investments in highways and bridges for all levels of government of $31.6 billion in 1988, of which approximately 60 percent comes from State and local sources. [19]

The type of investment foreseen varies based on highway system and geographical location. For example, FHWA envisions reconstruction with added lanes, resurfacing, and major widening to be the primary needs of both urban and rural interstates, as well as other urban freeways, expressways, and principal arterial roads. Similarly, minor urban arterial and collector roads will need major widening and resurfacing to accommodate increased traffic, but rural arterials and collectors will need less widening and more resurfacing and pavement reconstruction. [20]

It is important to realize, however, that the "constrained full needs" approach does not include all highway improvements that may actually be made. For example, bridges are cataloged separately from FHWA's Highway Performance Monitoring System and might involve an additional annual outlay of $5 billion to remove all deficiencies. [21] Furthermore, local roads are omitted from this analysis, as are the 11,000 to 15,000 additional lane miles that may be built to relieve urban and rural congestion if right-of-way problems can be overcome.

The foregoing summary indicates that, although demographic trends suggest a decrease in travel growth in this decade and the early 21st century, there will be more people demanding greater mobility, and existing deficiencies call for remedies, fueling arguments for maintaining or increasing capital spending on highways and bridges. However, it must be remembered that "needs" estimates, including those of the FHWA, may be on the high side.

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[17] House Public Works Committee, *Status*, p. 94.
[18] Ibid., p. 95.
[19] U.S. Congressional Budget Office. Unpublished estimates based on OMB historical data, April 5, 1990. For a detailed discussion of highway spending trends see U.S. Library of Congress. Congressional Research Service. *Federal, State, and Local Highway Spending: Update on Trends and Implications*. Report No. 90-433 E, by J. F. Hornbeck. September 10, 1990.
[20] House Public Works Committee, *Status*, p. 107-08.
[21] This number is disputed by some. See U.S. Library of Congress. Congressional Research Service. *The Bridge "Crisis": An Economic Development Perspective*. Issue Brief No. 88085, by J. F. Hornbeck. Archived April 19, 1990. p. 3.

Additionally, there is potential for various nonconstruction solutions to traffic management. These include technological and managerial innovations such as Intelligent-Vehicle Highways Systems, which are automated traffic control systems with on-board (in-car) navigation equipment that directs traffic around actual and potential congested areas, thereby avoiding gridlock. These types of solutions, combined with incremental increases in capital spending on highways and bridges from State and local as well as Federal coffers, might go a long way toward meeting future mobility needs.

FUTURE TRAVEL DEMAND: STAGNANT TRANSIT RIDERSHIP

Transit is less well positioned than highways to meet future mobility needs. The decreasing demand for public transit evident since (and actually before) World War II has been well documented. As Figure 2 demonstrates, transit ridership fell precipitously from 1945 to 1972, rising only slightly from 1972 to 1980, in part because of increased Federal Government assistance. From 1980 on, ridership has remained fairly constant, albeit at close to historically low levels, demonstrating transit's seeming inability to attract new riders. Table 3 points to similar trends for specific types of transit use over the previous decade. Although trends in transit use vary according to the size and location of cities, some enlightening generalizations may be made. [22]

Urban Mass Transit Administration (UMTA) data demonstrate that despite the fact that the number of rides has actually been relatively constant for nearly two decades, the increase in suburban-to-suburban traffic has resulted in transit's share of urban mobility falling from 3.6 percent of trips in 1969 to only 2.6 percent in 1983. Between 1970 and 1980, transit actually continued to capture approximately the same portion of suburban-to-center city commuting (11.5 percent) that it did in the previous decade; the portion of total commuting that these trips represent, however, has fallen. As a result, transit constitutes a declining portion of total urban and suburban trips.

Although transit's share of total trips declined, it still plays an important role in the largest metropolitan areas, particularly those older cities that were built up around transit systems. This is most pronounced during peak periods of commuting. However, from 1970 to 1980 even ridership among transit's traditional users, central city residents, fell from 21 to 16 percent of work trips. [23] Overall, transit is not a dominant commuting mode. Given the increasing decentralization of job growth and settlement patterns, it appears that with the exception of some urban centers, large transit systems hold limited promise for meeting future transportation needs.

Commuting is primarily metropolitan in nature and remains one of the biggest transportation bottlenecks. Existing transit infrastructure has not adequately addressed changing transportation demand. A classic transit solution to transportation involves establishing fixed-route rail systems or inflexible bus routes often using large vehicles. For this reason, transit cannot easily resolve conges-

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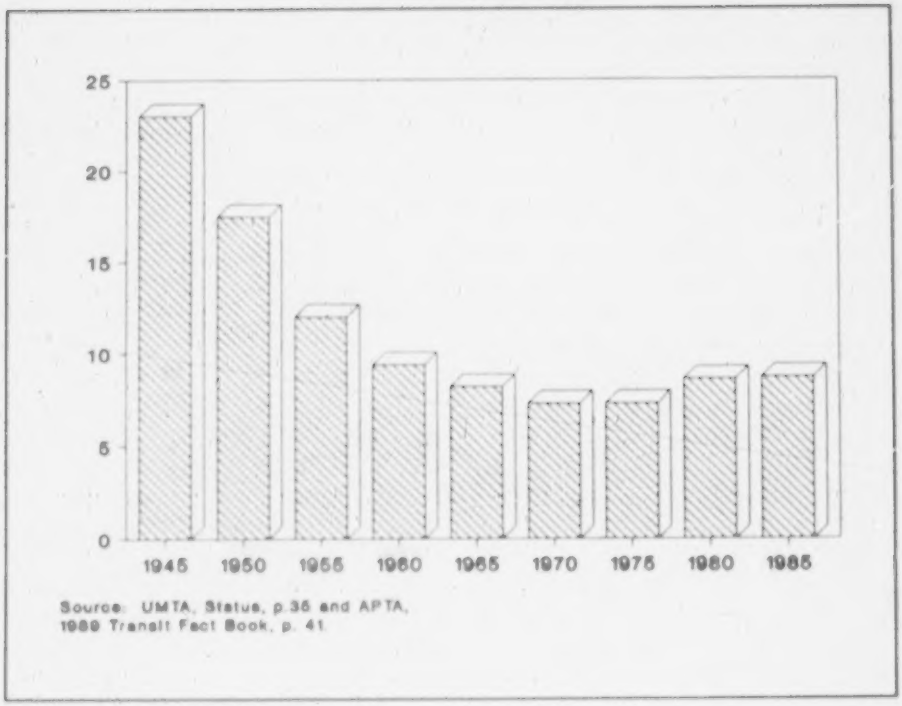
[22] U.S Department of Transportation. Urban Mass Transit Administration. *The Status of the Nation's Local Mass Transportation: Performance and Conditions*. Washington, 1988. p. 34.
[23] Ibid., p. 52.

FIGURE 2. Transit Ridership
1945-85
(billions of unlinked trips)



Source: UMTA, Status, p.36 and APTA, 1989 Transit Fact Book, p. 41.

TABLE 3. Transit Use Trends

(millions of rides)

Year	Rail	Trolley	Bus	Other	Total
1980	2,521	142	5,837	67	8,567
1981	2,485	138	5,594	67	8,284
1982	2,510	151	5,324	67	8,052
1983	2,566	160	5,422	55	8,203
1984	2,655	165	5,908	123	8,851
1985	2,697	142	5,675	145	8,659
1986	2,769	139	5,742	152	8,802
1987	2,846	141	5,624	155	8,766
1988	2,787	136	5,767	177	8,867

NOTE: Data in Table 3 have been split into two groups because transit statistics collected after 1983 capture previously excluded rural, small system, and demand response data.

SOURCE: American Public Transit Association, *1989 Transit Fact Book* (Washington) August 1989, p. 41.

tion and mobility problems stemming from decentralized living in suburban America. This is the result of the same demographic realities discussed above: the geographic dispersion of jobs and houses, rising incomes and car ownership, and greater mobility independence of women, the elderly, and other traditionally "transit-

dependent" groups.[24] In other words, the same trends responsible for clogging highways are keeping ridership down on buses and commuter rail cars.

Transit suffers from relatively high economic (money) and opportunity (time) costs relative to the private automobile. In many cases, there is little or no difference in the actual costs of riding transit compared to driving a car. Given that transit often involves longer commuting times, particularly for buses, and may often have fewer amenities than an automobile, many people will choose to drive rather than take public transportation, where possible. Transit advocates might point out that the true costs of automobile use are not being borne by drivers, particularly if negative externalities such as pollution and congestion are factored in. Until transportation pricing more closely reflects actual costs, transit's difficulties in competing with the private automobile will likely continue.

Both demographic and income trends encourage greater use of the private automobile to the detriment of transit. This has led, in turn, to continuing inefficiencies in much of the transit business, as load factors and revenue per transit vehicle mile remain generally very low. The result poses a difficult problem with respect to financing of transit infrastructure and operating subsidies for a mode of transportation that plays a less and less important role in meeting the mobility needs of society as a whole.

Because of the inherent drawbacks of rail systems and large buses, some transit specialists suggest that future transit solutions may incorporate more flexible answers, such as use of smaller buses and more elaborate routes to meet the commuting needs of suburban areas.[25] It is not clear, however, that even these adjustments will boost transit ridership noticeably in sprawling metropolitan areas.

In making public capital investment decisions, current demographic and travel patterns suggest that new transit solutions will likely be incorporated into plans to maintain and expand highways, roads, and bridges. As might be suspected, these trends indicate that transit systems cannot provide the investment returns, for example, of highway rehabilitation. Therefore, from an economic perspective, traditional transit solutions may simply not present many viable capital investment alternatives for dealing with suburban congestion and other mobility problems given current pricing incentives.[26]

Nonetheless, there are other factors that need to be considered in determining the fate of transit systems. Transit is a primary transportation option for certain segments of the population that often do not drive: those who cannot afford to purchase a car, young and elderly travelers, and the handicapped. Environmental concerns, such as the pollution output of cars, also argue in favor of mass transit. Furthermore, because these systems (particularly rail) are in place and provide some relief for congested roadways, arguments

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[24] Ibid., p. 62-63.
[25] Ibid., p. 167.
[26] Ibid., p. 163 and U.S. Congressional Budget Office. *New Directions the Nation's Public Works*. [Washington] September 1988. p.44-45.

continue to be made favoring subsidization. Ultimately, the decision to invest in transit may be a matter of social as much as economic policy.

Estimating future transit investment needs is even more difficult than for highways and bridges because it requires assumptions regarding future *desired* levels of assistance in the face of stagnant ridership levels. UMTA suggested in 1987 that $17.9 billion would "achieve 100 percent of the benefits available from rail modernization programs" carried out over a ten-year period.[27] This compares to a fiscal 1989 appropriation of $2.0 billion for capital improvements (including bus purchases). The benefits of the marginal dollar spent in UMTA's example declined appreciably, however, suggesting that as much as 84 percent of these benefits to rail systems could be had for as little as 50 percent of the dollar outlay ($9 billion).

Transit, it must be remembered, is a local transportation enterprise. Despite Federal assistance, any decision to upgrade transit facilities will include a major commitment from State and local governments. Federal policy in this light must be considered as one of subsidizing initiatives originating below the national level. In this sense, behind Federal transit investments may be a policy of following local leads rather than initiating at the national level, although in the past many local initiatives were not considered until a Federal financial match could be secured.

In general, demographic trends to the turn of the century indicate that, other things being equal, investments supporting public transit, as with individual travel, may best be made in highways, roads, and bridges. These types of investments will accommodate growing use of small vehicles in public transit, as well as the individual driver. Exceptions may exist in some cases, such as the rail initiatives in California, but the diverse traveling patterns of the 1990s present transit with its greatest challenge.

Air Transportation and the Demographics of Congestion

Aviation presents different challenges for demand management and public capital investment than either highways or transit. Unlike surface transportation, demand for air travel is very sensitive to the cost of travel (ticket price). Although air travel demand grew remarkably in the last decade, it has remained flat since 1988. Much of this is due to the effects of deregulation, which stimulated demand through intense price competition in the 1980s, but is now leading toward renewed concentration of the industry and higher ticket prices. Nonetheless, many expect demand to increase through the turn of the century, increasing congestion at major hubs.

A lack of adequate airport capacity in certain cities is the foremost problem facing aviation in the 1990s. Although there are some 6,000 public-use airports in the United States, only 494 receive regularly scheduled passenger service. Slightly more than half of these are designated by the Federal Aviation Administra-

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[27] The National Council on Public Works Improvement. *The Nation's Public Works: Report on Mass Transit*, prepared by the Urban Institute. Washington, 1987. p. 21.

tion (FAA) as primary airports, or those that receive most of the commercial air traffic. [28]

Of the major airports (with which most of flying public is concerned), the top 100 handle 95 percent of all airline passengers, the top 25 carry 67 percent of this traffic and the top 10 approximately 40 percent. This is the result, in part, of increasing concentration of the airline industry but, more importantly, of the greater use of hub-and-spoke operations to route traffic. Although most delays are weather related, 1990 operations at 22 of the busiest airports were limited by capacity problems, a number that some expect to double before the turn of the century, potentially affecting the majority of air travelers. [29]

To complicate matters, congestion is a system problem; once a major airport begins to experience serious delays, a "ripple effect" can occur in which schedules are disrupted throughout the county. Aviation congestion, therefore, is more than a simple demand problem, but also one of managing supply throughout the system to optimize traffic flow for any given level of traffic. [30]

The solutions to aviation congestion are complex and multifaceted because seemingly simple alternatives, such as building more airports, are least practical. This is due to the high costs involved (of both land and construction), local political opposition to environmental impacts (noise), and the lead time needed to complete these projects. As an alternative to building more capacity, short-term solutions often involve devising greater operational efficiencies with existing facilities, an option that although practical, has been virtually exhausted at some airports. [31]

Long-term solutions to aviation congestion will no doubt involve both public and private capital investment, which for aviation infrastructure means constructing or expanding airports and improving the air traffic control (ATC) facilities. Both receive funding from the aviation trust fund, with the latter fully financed at the Federal level. But spending is done at the State and local levels as well. In fact, the largest airports generate most of their development capital from operating revenues, with Federal grants for airports contributing to no more than 20 percent of total airport spending.

FUTURE TRAVEL DEMAND: GROWTH IN AVIATION CONGESTION

The FAA expends considerable effort attempting to forecast future demand for air travel, in part to anticipate which airports and communities will be most affected by this demand growth. FAA forecasts are very sensitive to many variables that are difficult to predict such as the price of aviation fuel and general economic conditions, just to name two. Unanticipated changes in either could drastically alter demand for air travel. [32] Demograph-

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[28] Transportation Research Board. *Future Development of the U.S. Airport Network: Preliminary Report and Recommended Study Plan*. Washington, 1988. p. 7.

[29] Ibid., p. 7 and Transportation Research Board. *Future Aviation Activities: Sixth International Workshop*. Circular Number 352. Washington. February 1990. p. 18.

[30] Ibid., p. 18.

[31] Transportation Research Board, *Future Aviation Activities*, p. 18.

[32] The Transportation Research Board has made demand forecasts to 2050, but the range of final demand varies by some 160 percent. For this reason, the following discussion focuses on

Continued

ic assumptions have been incorporated into FAA forecasts only in recent years but are expected to become more important in future projections. [33]

Regional realignments of population may affect specific airports according to a recent analysis cited by the FAA. Noting the same internal migration patterns discussed in the Section II of this report, and accounting for migration from abroad, it has been observed that from 1980 to 1988 nearly 90 percent of national population growth occurred in the South and West. [34] It may not be surprising then that, based on total operations in 1988 (including both commercial and general aviation), eight of the top ten airports are located in either the South or the West. [35] Demographic projections for the turn of the century suggest that airports in these areas could continue to experience growth rates above the national average, requiring specific measures to increase capacity.

Commercial air service, however, is often concentrated in markets that fall outside of the fast growing South and West. For example, New York and Chicago represent large commercial hubs. Furthermore, hubs need not be huge urban centers; North Carolina has two important hubs at Raleigh and Charlotte, neither of which would be selected as a hub based solely on population size. Demographic trends, therefore, may no. be as useful for understanding the nuances of aviation demand as they are for surface transportation.

Demand for air service can be measured in a number of ways, all of which are instructive for predicting future aviation needs. Aviation system use, in terms of commercial revenue passenger miles, stood at 330.6 billion in 1985. This number grew to 416.0 billion in 1988 (an increase of 26 percent) and is expected to more than double from 1985 to 2001, reaching a total of 765.6 billion. Total passenger enplanements, which are expected to grow from 448.5 million in 1988 to 743.5 million by 2001, further demonstrate this trend. [36] Even higher growth occurred in 1989 for regional/commuter operations, which are expected to more than double by 2001. [37] Commercial and regional/commuter air traffic would place the greatest pressure on many of the already congested primary airports.

General aviation (GA) traffic is also expected to increase by 2001, although at considerably slower rates. The number of active GA aircraft is expected to increase slowly through the 1990s from 210.3 million in 1989 to only 222.4 million in 2001. Total hours flown will increase slightly faster at an average of 1.5 percent annually to 2001. [38]

FAA forecasts for only the next ten years. See Transportation Research Board, *Future Development*, p. 11-13.

[33] U.S. Department of Transportation. Federal Aviation Administration. *FAA Aviation Forecasts: Fiscal Years 1990–2001*. FAA-APO 90-1, March 1990. Washington, 1990. p. 23.

[34] Transportation Research Board. *Aviation Forecasting Methodology: A Special Workshop*. TRB Circular 348, August 1989. Washington. p. 52 and FAA, *Aviation Forecasts*, p. 23.

[35] FAA, *Aviation Forecasts*, p. 136. The top ten airports are: Chicago O'Hare, Atlanta, Dallas/Ft. Worth, Los Angeles International, Orange County/John Wayne, Denver Stapleton, San Francisco International, Van Nuys, Phoenix, and Boston.

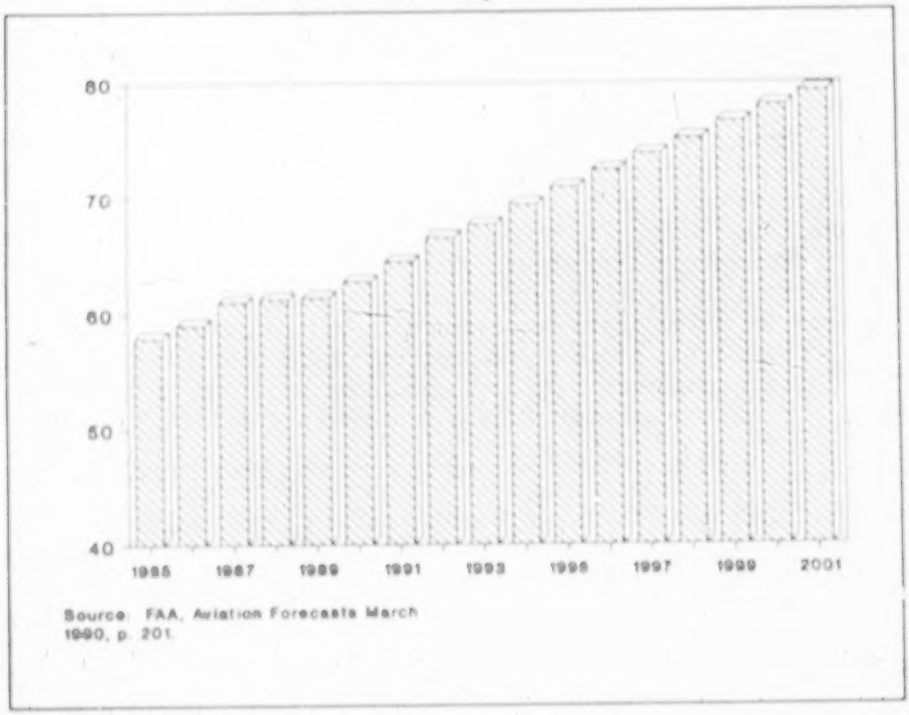
[36] This estimate falls within the 720 to 799-million range estimated in a semi-independent forecast. See Apogee Research. *A Strategic Plan for the Nation's Airport System*. Washington, 1990. p. 37.

[37] FAA, *Aviation Forecasts*, p. 5, 60-64, 82, and 186.

[38] Ibid., p. 99-101, 195, and 197.

To measure increases in system use, the FAA forecasts tower activity or total operations at airports with FAA traffic control service. In 1989, aircraft operations reported by the 399 airports with FAA-run towers reached 61.4 million, representing steady growth through the 1980s largely because of increased demand for commercial air service. Growth of FAA tower activity, as represented in Figure 3, is expected to increase at an average annual rate of 2.1 percent, reaching 79.2 million operations by 2001. [39]

FIGURE 3. Total Actual and Projected
Aircraft Operations at Airports with
FAA Traffic Control Service
(in millions of operations)



Source: FAA, Aviation Forecasts March 1990, p. 201.

Although a 2.1-percent annual increase in tower activity may not seem like a dramatic jump in demand, it must be remembered that in addition to being nearly three times the projected rate of national population growth (see Table 1), capacity constraints already limit growth in aviation at many of the more heavily used airports; without increasing capacity, some of the future demand for air services may go unmet. In fact, some argue that without immediate changes in public policy leading to construction of new airports and expansion of existing congested facilities, meeting future demand for air travel much above current levels may not be possible. [40]

Growth in demand for air travel as estimated by the FAA, however, may be too high. As Figure 3 suggests, projected growth in

[39] Ibid., p. 122 and 201.
[40] Labich, Kenneth. Airport 2000-A Horror Story? *Fortune*. June 18, 1990. p. 104-110.

aircraft operations to the turn of the century would exceed trends experienced during the 1980s, widely regarded as an acute growth period. Whether these trends can continue, particularly with significant increases in air fares and the prospect of slower long-term economic growth, is certainly questionable.

Nonetheless, a recent Gallup poll suggests that the popularity of flying is increasing, as is the number of people who have flown at least once or flown in the past twelve months.[41] It is possible that as the baby-boom generation ages (and moves into higher income brackets), the demand for both business and vacation flying will increase, perhaps approaching FAA projections. Irrespective of the accuracy of any given projection, it seems clear that growth in air travel will continue and that greater demands will be made for expanding capacity.

Adding infrastructure is an important option for increasing aviation capacity; it is, however, only one of several key strategies that can be used in the decades to come. For example, short-term solutions such as better management of demand for air travel with either a regulatory or pricing approach, or rerouting traffic around or away from the most congested airports are sure to be implemented. In addition, other long-term options (beyond the ten-year horizon adopted for this report) will likely include developing alternative modes of transportation, such as high-speed rail (including magnetic levitation) and incorporating advancements in the air-traffic control (ATC) system beyond current expectations. Nonetheless, increasing capacity through construction of infrastructure remains a fundamental option for many airports.[42]

CAPITAL INVESTMENT SOLUTIONS TO CONGESTION

Capital investment solutions to augment capacity, involve construction and expansion of airports and runways, and implementation of ATC improvements. The first provides new space on the ground with which to increase landings and takeoffs. The second is a technological solution involving enhanced computer capability designed to allow closer spacing of aircraft and other efficiency gains that will increase capacity in the air. Both are medium to long-term solutions that may help alleviate congestion in the coming decade and beyond.

The FAA readily acknowledges that airport expansion, where possible, will be a major part of any strategy to increase capacity. Such a strategy would encompass taxiway and apron improvements in addition to runway construction or extension as a means to increase maneuverability on the ground. Together, these projects accounted for 75 percent of Federal funding for airport improvement at the top 100 airports in fiscal 1988.[43] Without increased runway capacity, the FAA indicates that airports experiencing 20,000 hours of delays would increase from the current 22 to 39 by 1997. As of

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[41] The Gallup Organization, Inc. *Air Travel Survey 1989*. Princeton, 1989. p. 2 and 12-17.

[42] Apogee Research, *A Strategic Plan for the Nation's Airport System*, p. 44-47 and TRB, *Future Development of the U.S. Airport Network*, p. 40-44.

[43] U.S. Department of Transportation. Federal Aviation Administration. *Airport Capacity Enhancement Plan*. Washington, 1989. p. 5-3.

1989, however, 50 of the largest 100 airports had plans for building new runways or extending existing facilities. [44]

In 1986, the FAA projected that to make all needed improvements to commercial, reliever, and general aviation airports would require $24.3 billion over ten years. The Federal contribution outlined in the 1991 annual budget request from FAA is $1.8 billion for the airport improvement program. [45] It must be remembered, however, that airports are locally operated and financially supported. Federal contributions, therefore, should be viewed as only a small part of any funding solution. In fact, of the major expansion projects needed throughout the country, most will be at major airports that are capable of financing these improvements on their own. Left to respond to market forces, airlines, large airports, and local governments may provide many of the answers to aviation congestion.

Managing airspace more efficiently falls to the Federal Government. Solutions to airspace management rely on automation advancements to be had with implementation of the National Airspace System (NAS), a multibillion-dollar modernization scheme to upgrade air-traffic control facilities across the country. This includes purchases of enhanced computer software and hardware, radar and displays, communications equipment, weather-tracking systems, and navigational aids. Despite significant delays, modifications, and increasing costs, the NAS plan is scheduled to be brought on line during the 1990s at a cost of some $16 billion. Federal financial support for this program is evident in the $2.1-billion FAA budget for facilities and equipment programs in FY91 (an increase of 22 percent over FY90). These funds are available in large part to finance the NAS plan. [46]

Although the Congressional Budget Office has suggested that the NAS plan provides a good return on public investment, it also points to the fact that the upgraded traffic control may not be able to relieve much of the congestion at major airports. [47] Some critics of the NAS plan go so far as to suggest that delays may have allowed the proposed new system to approach obsolescence before it is implemented. For example, some contend that advances in communications technology using satellite-based systems may provide greater operating efficiencies at lower costs than the ground-based NAS plan. [48]

Although the FAA considers the satellite-based option to be the next technological breakthrough after the current NAS plan is in place, critics charge that it could be incorporated much sooner, per-

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[44] Ibid., p. 3-1.

[45] The National Council on Public Works Improvement. *The Nation's Public Works: Report on Airports and Airways*. Apogee Research Inc. Washington, May 1987. p. 37-38. Also U.S. Congress. House. Committee on Appropriations. Subcommittee on the Department of Transportation and Related Agencies Appropriations. *Department of Transportation and Related Agencies Appropriations for 1991*. Hearings. 101st Cong., 2d Sess., Part 2. Washington, U.S. Govt. Print. Off., 1990. p. 186.

[46] U.S. Congress. House. Committee on Appropriations. *1991 Appropriations*, p. 200 and Office of Management and Budget. *Budget of the United States Government Fiscal Year 1991*. Washington. p. 134-35.

[47] U.S. Congressional Budget Office, *New Directions*, p. 69.

[48] U.S. Congress. House. Committee on Public Works and Transportation. Subcommittee on Aviation. *FAA's Facilities and Equipment Account and Air Traffic Control Modernization*, p. 125-32.

haps within the same time frame as the ground-based NAS plan. Regardless of when such a system is adopted, the need for continued capital investment in both airports and the air-traffic control system appears to be inescapable, regardless of demographic changes.

Conclusions and Outlook

At the outset of this paper, it was postulated that the demand for transportation is related to many variables including population, economic growth, income, and the price of transportation. Certainly other considerations may be involved, but these factors are generally considered among the most important. At the start of the 1990s, most demographers and economists agree that the United States is facing a time of slower growth in both the economy and population, as well as a time of higher prices for transportation services given that world events and recent changes in the tax code are likely to encourage higher petroleum prices.

These basic trends might indicate that *growth* in demand for transportation will fall, perhaps resulting in a decrease in public capital investment needs. For many reasons, however, it seems that the three modes of transportation discussed above may still require significant levels of public capital investment, regardless of the anticipated slower growth in system use. Changing demographic trends, although useful in forecasting demand, may not be as practical for determining direct relationships with public capital investment. In part, this reflects the myriad of social, economic, and political considerations that govern decisions to make large capital investments in infrastructure. But it still raises the fundamental question of why needs may be high given various broad declining trends?

In the case of highways and bridges, declining use trends and higher gasoline prices are virtually inevitable. Nonetheless, there are still some segments of new construction, particularly in urban areas, that require funding, not to mention the vast backlog of rehabilitation costs that have accrued because of systematically deferred maintenance at all levels of government. The cost to repair many projects increases dramatically when capital replacement is used as a substitute for timely preventive maintenance.

Traffic growth, although slowing, is still most heavily concentrated in urban areas. Peak-hour congestion remains an irritating problem and one that will find relief, at least in part, from increased capital investment. This will include both new and rehabilitated roads and bridges. Some alternatives to increased road building, such as Intelligent-Vehicle Highway Systems, are expensive propositions in their own right.

Once built, highways and bridges usually require maintenance expenditures that do not vary dramatically with growth in travel use. Declining growth trends, therefore, do little to reduce maintenance and replacement costs. Although slower growth trends might theoretically translate into longer useful lives for these assets, traffic volume is only one factor that causes road deterioration. Many roads and bridges succumb to the effects of bad weather and salt treatments used to keep roads passable during the winter months.

Mass-transit is a better example of a transportation mode facing the economic realities of low use. Although subsidized at the Federal level, transit is primarily a local issue with high costs of operation. Despite the position of transit advocacy groups, it is possible that stagnant demand may lead to slightly lower investments in the transit option.

Finally, air travel will continue to grow. Although projections by the FAA and others may seem high, there are many indications that the preference to fly is very strong within reasonable price ranges. Demographic and income trends may be misleading indicators of air-travel demand and the need for public capital investment.

The airlines, in attempts to maximize passenger loads and reduce operating costs, have adopted hub-and-spoke systems for managing air traffic. One result of this decision is the greatly enhanced use of a relatively small number of principal hub airports. This has resulted in increased traffic congestion and capacity constraints at many of the busiest airports during peak flying periods. Consequently, many advocate increasing "airside capacity" (runways and aprons), which would require large amounts of public as well as private capital investment.

The need for improvements to the air-traffic-control system will also mean increased capital spending in the 1990s. Upgrades for this system are required to improve air capacity throughout the country, regardless of the actual volume of travel demand that may be anticipated. In short, demographic and economic trends may not have the dampening effect on air travel and infrastructure needs that might be thought.

The United States may be entering a period of reduced growth in many aggregate economic and demographic variables. Nonetheless, the vast array of public capital transportation assets, valued in excess of $500 billion, will continue to command significant outlays on an annual basis. These outlays may be lower in real terms than those experienced from the late 1950s to the early 1970s. That was a period when much of the Nation's infrastructure was expanded. Future infrastructure outlays may, however, be higher than those committed in the late 1970s and early 1980s, a period widely regarded as one of disinvestment in public capital resources.

Another way to view the relationship between demography and infrastructure is to think of the 1990s as a time to reduce the backlog of public capital investment needs. Those who argue that there was systematic underspending on infrastructure in the late 1970s and early 1980s, compared to gross national product (GNP) or other aggregate measures, may see declining growth trends in demographic and economic variables as an opportunity to catch up on infrastructure requirements simply by maintaining or modestly increasing spending in real terms.

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VIII. IMPLICATIONS OF DEMOGRAPHIC CHANGES FOR WASTEWATER AND WATER-SUPPLY INFRASTRUCTURE

by Claudia Copeland *

As the 21st century approaches, policy makers are beginning to examine recent and projected changes in the social, economic, and demographic structure of U.S. society and new or modified policies appropriate to such changes. It has been said that, "Demography is not destiny, but it is a very fundamental influence in shaping the course of human events." [1] However, demography's role in guiding policymaking will vary. Some policy areas are necessarily quite sensitive to demographic concerns; for example, an aging population has direct implications for services such as health care and retirement income programs for the elderly segment of the population.

Other broad areas of public policy are less influenced by demographics. The area called public works infrastructure—the system of highways, airports, water systems, and buildings—is mixed in this regard. Elements of the Nation's infrastructure related to transportation and housing needs are closely linked to population growth and economic trends, [2] while policies concerning wastewater and water supply systems are dependent on these and other factors, such as environmental mandates.

The systems which comprise wastewater and water supply infrastructure are quite sensitive to changes in the pattern of residential moves and much less sensitive to other demographic factors, such as age of the population, or racial and ethnic composition. There is little information which suggests, for example, that a given population which is growing more elderly will impose notably different requirements on water systems than a younger population. Total population and regional movement are the relevant issues for wastewater and water supply public works.

This section examines several questions about the impacts of demographics on water system infrastructure. First, what role does population change play when local governments and States plan these systems? Second, what evidence do we have that population change is reflected in the current planning of water system managers? Third, what implications do population changes suggest for Federal policy?

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[1] Population Reference Bureau, *American in the 21st Century: A Demographic Overview*. Washington, 1989. p. 2.

[2] Population Reference Bureau. *America in the 21st Century: Infrastructure Needs*. Washington, 1990. 24 p.

Background: Water Supply and Wastewater Planning

As background, it is useful to understand the factors that are relevant to water supply and wastewater planning.

Components of the water supply infrastructure include intake structures, storage and conveyance systems, centralized facilities where raw water supply is purified or treated, and distribution pipes and systems to deliver treated water to the consumer. Components of the wastewater infrastructure include collection systems and sewers which collect and convey domestic and other sewage to facilities which remove wastes from the influent and discharge treated effluent to a receiving water or to groundwater recharge; and related facilities which handle disposal of wastes removed from the influent stream.

Planning these types of public systems is interrelated, since 60 to 80 percent of the total water supplied to a community becomes wastewater; the remainder represents outdoor use (mainly for gardening and lawn watering), water used for public purposes such as fire protection, or is unaccounted for, due to leakage from aged water and sewer lines. A summary of data on water supply and wastewater systems is presented in the Appendix.

Similar considerations apply to water supply and wastewater planning. Both are driven primarily by demand; that is, the hydraulic pumping and flow capacity of the system must be sized to meet peak demands. As discussed later in this report, demand can be influenced by pricing and regulatory measures which encourage users to conserve or shift demand to non-peak periods, thus potentially reducing peak demand.

Both the demand for water supply and rates of wastewater flow may fluctuate on an hourly, daily, weekly, monthly and yearly basis. Consequently, the peak demand, which is critical to facility planning, may in fact be of short duration, yet it strongly affects investment requirements. Seasonal variations may be relevant as well, as in the case of some commercial and industrial activities such as food processing, or institutional uses such as that of a college or university and its fluctuating population.

One author notes that predicting the water supply requirements of a public water system is an inexact science, as it is with wastewater systems. [3] However, textbooks and reference materials offer some guidance on planning. Important considerations include population projections and per capita consumption (which, in the case of water supply, is based on historic water use). Sewerage flow rates will follow water supply flow, unless there is extensive infiltration of sewers from rainfall, leakage from water supply pipes into the sewer system, or undocumented use of sewers, all of which result in flows greater than water supply flows.

A number of considerations influence planning a water supply system. These include: [4]

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[3] Wetzel, Mark L. "Water Supply or Water Deficiency?" *WATER Engineering & Management*. August 1990, p. 24.

[4] Viessman, Warren, Jr. and Mark J. Hammer. *Water Supply and Pollution Control*. Harper & Row, Publishers. New York, 1985. pp. 41–44.

- geographic location (local climate, principally temperature and rainfall, determine water demand for air conditioning and exterior uses such as lawn watering);
- the reliability and quality of data used in assessing water use trends and making forecasts;
- economic growth projections;
- environmental regulations which modify the amounts of water used (for example, to meet air quality standards electric-utility companies often install "scrubbers" to remove sulfur dioxide from stack gases; scrubbers consume large amounts of water); and
- existence of conservation programs which can reduce demand, especially during drought periods or other water supply shortages.

In the case of wastewater facility planning, the three most important factors are population projections, per capita wastewater flow projections, and the amount and type of industrial discharges to the system. Accurate estimates of sewage flows and reliable population studies are required, since the quantity of sewage generated by a community depends on its population. [5]

In addition to general considerations, applicants for Federal grant assistance for wastewater treatment facilities must meet a number of design restrictions. Since 1978, grants under the Clean Water Act are subject to Environmental Protection Agency (EPA) cost-effectiveness guidelines limiting size and reserve capacity to avoid overdesign or at least to preclude Federal grants from subsidizing overdesign. [6] Requirements apply to several factors.

- Forecasting no more than 20 years' population growth, in conformity with U.S. Department of Commerce procedures. EPA starts with the Census Bureau's middle-level projection of total national population growth. This projection, called Series II, represents a mid-range between low and high projections of future U.S. population.
- Estimating total system wastewater flows based on per-capita flow of 70 gallons per day. This volume represents an average dry-weather day, according to the EPA guidelines.
- Providing limited extra capacity for the wastewater system beyond that determined to be cost-effective. This permits inclusion of treatment plant and sewer capacity to serve 10 percent more than an area's projected population.

Prior to the standardization resulting from these guidelines, population projections were done entirely by the local community. Application of EPA's guidelines is intended to ensure reasonable consistency with State and national projections to maximize the amount of water pollution abatement per dollar of public expenditure. No similar national guidelines apply to water supply facility planning.

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[5] Ibid., p. 51.
[6] *Code of Federal Regulations*, Title 40, Part 35, Subpart E—Grants for Construction of Treatment Works, Clean Water Act, Appendix A, Cost-Effectiveness Analysis Guidelines.

Population Demographics and Wastewater Planning

Next we turn to the question of evidence that States take account of present and prospective population change in their planning for water supply and wastewater services. Analytically one must focus on wastewater treatment, in which Federal programs create standardized procedures in all States for planning, estimating current and future needs, and reporting. Using population projections together with information from the principal Federal program in this area (assistance for construction of wastewater treatment facilities under the Clean Water Act) is helpful in evaluating this question. Comparable information on water supply needs and planning is generally unavailable, because there is no comprehensive Federal program which could utilize or require such information.

POPULATION PROJECTIONS

For population projections, considerable information is available from the Census Bureau. Projection reports prepared by the Bureau in 1988 forecast declining population through the year 2000 in 13 States [7] and the District of Columbia and below-average growth in 18 others. They project above-average growth in 19 other States located primarily in the Southwest and Southeast, [8] including nine with more than double the average growth rate. [9] The geographical pattern of change is projected to be similar through the year 2010 (see the discussion in Section II above). These projections are based on the assumptions of the Bureau's Series II population projections, which also are utilized in EPA's cost-effectiveness guidelines for wastewater treatment grant planning. Early results from the 1990 Census, reflecting population changes since 1980, generally resemble the pattern of the 1988 projections for the next two decades. Since results from the Census will not be final for some months, they cannot yet be used to update the 1988 projections. [10]

The Census projections are consistent with other recent analyses which have focused on significant growth for the Nation's coastal regions. According to one such report from the National Oceanic and Atmospheric Administration, population density in coastal counties currently is nearly 350 persons per square mile, or more than four times the U.S. average. [11] Seventeen of the 20 States with the largest expected Statewide population increases from 1960 to 2010 are coastal.

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[7] Illinois, Indiana, Iowa, Kentucky, Michigan, Montana, Nebraska, North Dakota, Ohio, Pennsylvania, West Virginia, Wisconsin, and Wyoming.

[8] Alaska, Arizona, California, Colorado, Delaware, Florida, Georgia, Hawaii, Maryland, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, South Carolina, Texas, Utah, Virginia, and Washington.

[9] The nine are Alaska, Arizona, California, Florida, Georgia, Hawaii, Nevada, New Mexico, and Texas.

[10] Wetrogan, Signe I. *Projections of the Population of States, by Age, Sex, and Race: 1988 to 2010.* U.S. Department of Commerce, Bureau of the Census. Current Population Reports. Population Estimates and Projections. Series P-25, No. 1017. October 1988. 118 p. See especially discussion concerning Table F, p. 6.

[11] U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service. *50 Years of Population Change Along the Nation's Coasts, 1960–2010.* Washington, 1990. 41 p.

This NOAA report discusses each of five coastal regions (defined as Northeast, Southeast, Gulf of Mexico, Pacific, and Great Lakes). Even in the Northeast, which the Census Bureau projects will grow by only 2.4 percent in the 1990s and 1.3 percent in the following decade, the coastal population will grow more rapidly than the region as a whole, although the Northeast coastal region is expected to experience lower than average growth over the next two decades when compared to the entire United States.

NOAA observes that the Southeast coastal region has the smallest population among coastal areas, yet its population is projected to increase by 181 percent (the highest of the five coastal regions) between 1960 and 2010. Between 1988 and 2010, one-third of the coastal counties in this region are projected to have population increases of 35 to 75 percent. Eastern Florida will dominate population trends in this region, as more than 80 percent of the fastest growing counties in the Southeast region are located in eastern Florida.

As some regions of the country—Southwest, Southeast, and other coastal areas—become more densely populated, one point is clear: the land area in these regions will not expand, and it becomes more important to plan for and manage the direct and indirect effects of this growth. These effects include increased demands on water, energy, other natural resources, and the waste treatment and disposal capacities of the regions; loss of ecological and economic values; and diminished environmental quality.

WASTEWATER TREATMENT PROGRAM

The principal Federal wastewater treatment program is contained in Titles II and VI of the Clean Water Act and provides authority for financial assistance and program requirements applicable to aid recipients. This is the key program directed at meeting wastewater treatment needs in all regions of the country. It is administered by the Environmental Protection Agency (EPA). Federal law has authorized grants for planning, design, and construction of municipal sewage treatment facilities since 1956 (P.L. 84-660). Since 1972, when the prior program was expanded, Congress has authorized $59 billion and appropriated $50 billion for grants to aid wastewater treatment plant construction. Since 1980, annual appropriations have averaged $2.3 billion.

Grants are allocated among the States according to a complex statutory formula. Assistance is available, in turn, to sub-State jurisdictions for types of projects (such as secondary or more stringent treatment and associated sewers) based on a priority list established by the States. Projects which are not eligible for Federal funds are the responsibility of State and local sponsors.

In 1987 Congress modified the prior program, which consisted of Federal grants matched either 25 percent or 45 percent by non-Federal funds (depending on the type of project involved). Under Title VI of the Act, established in 1987, an $8-billion program of grants to capitalize State Water Pollution Control Revolving Funds, or loan programs, is authorized for fiscal years 1989 through 1994. States will contribute matching funds and, under the revolving loan fund concept, monies used for wastewater treatment construc-

tion will be "recycled" for future construction in other communities. Unlike the prior grant program, which required no repayment of Federal funds, monies received under the revolving loan program are to be repaid to the State. The 1987 amendments envision that Federal assistance under the Clean Water Act will end altogether after 1994 and that States will bear full responsibility to finance such programs thereafter.

The current Clean Water Act allotment formula, adopted in 1987 and applicable to assistance through fiscal year 1990, is based on States' needs for funding certain categories of wastewater treatment projects—primarily the basic treatment plant and associated sewers—plus some weighting or special treatment for the least populous States. Since first adopted in 1972, the statutory formula for grants distribution has been modified several times. In contrast to the current formula which gives a slight preference to small States, the formula governing distribution of Federal aid under the 1972 program explicitly gave some preference to States with large and growing populations. Grants to aid in meeting the wastewater treatment needs of future populations were allowed.

Over time, this program has evolved to provide less support based on growth factors, in order to focus Federal resources on projects to solve water pollution problems that meet the wastewater treatment needs of current population. Current policies reflect the view that Federal wastewater treatment aid programs should support wastewater treatment needs of existing populations, not economic development or population growth needs. Providing the wastewater treatment infrastructure for future populations thus is considered the responsibility of State and local governments. Projects to meet such needs are not eligible in general for Federal assistance under the current program and are not reflected in State-by-State distribution of grant funds under the statutory allotment formula.

It is not surprising, therefore, that when States are ranked according to the allotment formula in the current Clean Water Act, as shown in Table 1, no indication is present that States projected to gain or lose population in future years receive larger or smaller allotments, respectively. Nine of 19 States projected to experience significant population gains are below the median of all States (South Carolina is the median) under the current allotment formula, while nine of the 13 States plus the District of Columbia which are projected to lose population are above the median. It should be apparent that the current allotment formula bears little relationship to changing population—either increases or decreases.

State Funding Needs Reported in the EPA Survey

While future population and economic growth are not reflected in the distribution of Federal funds, States do plan for and estimate wastewater treatment requirements beyond the needs of current populations. Those plans and estimates include project categories ineligible for Federal aid under the Clean Water Act program, such as sewers needed to serve residential or industrial growth and major rehabilitation of aged sewer systems. Most communities plan for 20 years' growth in wastewater system infrastructure. Results

TABLE 1. Ranking of States by Clean Water Act Wastewater Treatment Allotment Formula

State	Allotment	State	Allotment
1 New York	0.111632	30 NEW HAMPSHIRE	0.010107
2 CALIFORNIA	0.072333	31 Kansas	0.009129
3 [Ohio]	0.056936	32 Mississippi	0.009112
4 TEXAS	0.046226	33 Oklahoma	0.008171
5 [Illinois]	0.045741	34 COLORADO	0.008090
6 [Michigan]	0.043487	35 HAWAII	0.007833
7 NEW JERSEY	0.041329	36 Maine	0.007829
8 [Pennsylvania]	0.040062	37 ARIZONA	0.006831
9 Massachusetts	0.034338	38 Rhode Island	0.006791
10 FLORIDA	0.034139	39 Arkansas	0.006616
11 Missouri	0.028037	40 ALASKA	0.006053
12 [Wisconsin]	0.027342	41 UTAH	0.005329
13 MARYLAND	0.024461	42 [Nebraska]	0.005173
14 [Indiana]	0.024374	43 NEVADA	0.004965
15 VIRGINIA	0.020698	44 [Wyoming]	0.004965
16 Minnesota	0.018589	45 South Dakota	0.004965
17 NORTH CAROLINA	0.018253	46 [Dist. of Col.]	0.004965
18 WASHINGTON	0.017588	47 [North Dakota]	0.004965
19 GEORGIA	0.017100	48 NEW MEXICO	0.004965
20 [West Virginia]	0.015766	49 Vermont	0.004965
21 Tennessee	0.014692	50 Idaho	0.004965
22 [Iowa]	0.013688	51 [Montana]	0.004965
23 Puerto Rico	0.013191	52 DELAWARE	0.004965
24 [Kentucky]	0.012872	53 Pac. Trust Ter.	0.001295
25 Connecticut	0.012390	54 American Samoa	0.000908
26 Oregon	0.011425	55 Guam	0.000657
27 Alabama	0.011309	56 Virgin Islands	0.000527
28 Louisiana	0.011118	57 Nor. Mariana Isl.	0.000422
* 29 SOUTH CAROLINA	0.010361	TOTAL	1.000000

* Median

NOTE: States shown in all capital letters are projected to experience above-average population gains over the next 20 years. States shown in brackets are those projected to experience population decreases, according to Census Bureau reports.

are provided in a biennial report to Congress prepared jointly by States and EPA.

This survey of needs reports the estimated costs of building the municipal wastewater facilities required to achieve and maintain water quality standards. The categories and sub-categories of projects for which costs are reported have evolved since the 1973 survey, which was the first one used as the basis for allocating grants under the Act. Currently the categories include treatment plant improvements, rehabilitation of existing sewer lines, construction of new collection sewers, construction of new interceptor sewers, and correction of overflows from combined storm and sanitary sewers.

Several factors severely restrict the year-to-year comparability of data in the surveys. First, the categories for reporting costs have expanded over time. Second, it is strongly suspected that, for several years following 1972, some States and municipalities may have inflated their need estimates in order to improve their relative share of grant monies. Since then, however, EPA's documentation criteria and analytical procedures have been refined to improve the accuracy of data reported in the survey.

As for the reliability of the estimates, EPA has stated consistently that the quality of data for the treatment plant and new interceptor sewer categories is the most accurate because of long government and industry experience with required technology and associated construction costs. For the categories which include sewer rehabilitation, collection sewers, and correction of combined sewer overflows, EPA has said the data are much improved today, compared with earlier surveys. Problems of non-uniform assumptions (as in estimating future populations to be served) were common in earlier years and led to EPA efforts to require consistency in planning and estimating, as with the cost-effectiveness guidelines discussed previously.

For the last two surveys conducted in 1986 and 1988, EPA required States to document their cost estimates according to an established list of 17 criteria. In the 1988 survey EPA disallowed State estimates totaling $16 billion for projects that lacked adequate documentation. Factors that determine acceptability include, for instance, the existence of a facilities plan and final engineering estimate, inclusion of a project on a State priority list approved by EPA, a formal sanitary survey that identifies an existing or historical public health problem, or an administrative or judicial order demonstrating a need to construct a project to correct an existing or long-standing problem. While no such survey is perfect, EPA's current procedures seek to achieve the most accurate assessment of wastewater needs possible.

The needs survey estimates are collected and reported by States in two ways. The first is by type of project; the second is by timeframe. The most recent of these reports, completed in 1988, indicates that States will require $68 billion to construct wastewater treatment plants to meet the needs of current populations, plus $15 billion more to meet the needs of projected population in the year 2008 (funding required for systems to serve populations that will exist in 20 years, but do not exist today).[12] Hence, existing unmet needs would require an average of $3.4 billion annually to be eliminated over 20 years, while services for new population would cost an additional $750 million per year.

Table 2 (Year 2008 Needs) ranks States according to total needs for wastewater treatment construction, both for current population and future growth. Table 3 shows a similar ranking for the $15.3 billion which is just the growth needs portion of the $83 billion total in Table 2. In Table 3, 11 of the 19 States projected to grow more than average show growth needs above the median of all States (Oklahoma is the median), while six of the States projected to lose population also are above the median.

A ranking based on total dollar needs, as in Tables 2 and 3, is bound to reflect a bias towards States with large populations. Thus, New York and California can be expected to have larger needs in total than less populous States, such as Montana or Wyoming. One way to correct for the effect of large population is to examine each State's growth needs as a percentage of its total needs (the ratio of

[12] U.S. Environmental Protection Agency. *1988 Needs Survey Report to Congress, Assessment of Needed Publicly Owned Wastewater Treatment Facilities in the United States.* Washington, 1989. 1 v.

TABLE 2. States Ranked by Total Wastewater Facility Needs

(millions of dollars)

State	Year 2008 Needs	State	Year 2008 Needs
1 New York	$12,721	* 27 MARYLAND	$ 919
2 CALIFORNIA	6,539	28 NEW HAMPSHIRE	854
3 FLORIDA	6,186	29 Alabama	781
4 Massachusetts	5,836	30 Kansas	720
5 TEXAS	4,975	31 SOUTH CAROLINA	684
6 NEW JERSEY	3,754	32 [Iowa]	646
7 [Ohio]	3,579	33 UTAH	583
8 [Michigan]	3,321	34 Mississippi	548
9 [Illinois]	2,958	35 Oklahoma	476
10 WASHINGTON	2,685	36 HAWAII	413
11 NORTH CAROLINA	1,799	37 Rhode Islaqd	408
12 [Indiana]	1,721	38 Arkansas	370
13 [Pennsylvania]	1,644	39 Maine	341
14 Puerto Rico	1,592	40 [Dist. of Col.]	278
15 Tennessee	1,467	41 ALASKA	221
16 [Kentucky]	1,457	42 Vermont	209
17 [Wisconsin]	1,399	43 COLORADO	196
18 Connecticut	1,392	44 NEVADA	165
19 Oregon	1,273	45 NEW MEXICO	130
20 Missouri	1,222	46 DELAWARE	127
21 Louisiana	1,189	47 Idaho	124
22 Minnesota	1,106	48 [Nebraska]	114
23 GEORGIA	1,007	49 South Dakota	87
24 ARIZONA	1,979	50 [Montana]	69
25 [West Virginia]	976	51 [North Dakota]	34
26 VIRGINIA	957	52 [Wyoming]	18
TOTAL			$83,249

* Median

NOTE: States shown in all capital letters are projected to experience above-average population gains over the next 20 years. States shown in brackets are those projected to experience population decreases, according to Census Bureau reports. Table excludes Guam, American Samoa, Pacific Trust Territories and Virgin Islands.

the entry in Table 3 to that in Table 2 for each State). This result is presented in Table 4. In the aggregate, growth needs represent 18.3 percent of total needs, but the range in individual States is considerable. As shown in Table 4, growth needs represent 51.6 percent of Alaska's total needs, at one extreme, and 1.4 percent of the District of Columbia's total needs, at the other extreme.

In Table 4, 15 of the 19 States projected to experience above-average population increases show growth needs as a percentage of total needs that are equal to or above the median for all States (California is the median). This result is consistent with what would be expected: States which project significant population growth should reflect those expectations in their infrastructure planning. In fact, it might be expected that all 19 of these States would be well above the median. However, one of the projected growth States (Maryland) ranks near the bottom in Table 4, suggesting that planners in that State may be focusing to a large extent on backlogged or current wastewater treatment needs while underevaluating future growth needs.

At the same time, two of the 14 jurisdictions projected to lose population (Kentucky and Iowa) also are above the median in Table 4, suggesting that these States either may be planning for

TABLE 3. States Ranked by Projected Growth in Facility Needs

(millions of dollars)

State	Growth Needs	State	Growth Needs
1 FLORIDA	$2,202	* 27 Oklahoma	$ 191
2 TEXAS	1,669	28 HAWAII	177
3 CALIFORNIA	1,282	29 NEW HAMPSHIRE	145
4 New York	1,038	30 [Indiana]	139
5 NORTH CAROLINA	587	31 Mississippi	138
6 Tennessee	569	32 [Iowa]	135
7 WASHINGTON	542	33 Connecticut	125
8 [Ohio]	438	34 [West Virginia]	124
9 ARIZONA	437	35 ALASKA	114
10 NEW JERSEY	403	36 Arkansas	113
11 GEORGIA	392	37 NEVADA	64
12 Massachusetts	391	38 Idaho	59
13 [Kentucky]	349	39 Maine	53
14 Louisiana	335	40 MARYLAND	53
15 Oregon	291	41 DELAWARE	45
16 UTAH	291	42 Rhode Island	44
17 Missouri	267	43 NEW MEXICO	38
18 SOUTH CAROLINA	243	44 COLORADO	33
19 Kansas	235	45 Puerto Rico	23
20 Alabama	234	46 [Nebraska]	15
21 [Pennsylvania]	205	47 [Montana]	12
22 Minnesota	204	48 Vermont	7
23 VIRGINIA	202	49 South Dakota	6
24 [Michigan]	196	50 [Dist. of Col.]	4
25 [Wisconsin]	195	51 [North Dakota]	3
26 [Illinois]	194	52 [Wyoming]	1
TOTAL			$15,252

* Median

NOTE: States shown in all capital letters are projected to experience above-average population gains over the next 20 years. States shown in brackets are those projected to experience population decreases, according to Census Bureau reports. Table excludes Guam, American Samoa, Pacific Trust Territories and Virgin Islands.

growth that is not likely to occur, perhaps because of growth expectations driven by earlier conditions or situations.

Finally, Table 5 builds on the information in Table 4 with the addition of a State ranking by the Census Bureau's projections of population change between 2000 and 2010 (the end of the period of time covered by EPA's most recent survey on projected wastewater facility funding needs).[13] This table indicates the extent to which States with the greatest projected population change (both increases and decreases) correlate with States that are planning to invest larger or smaller proportionate shares of wastewater treatment funds in projects to meet the needs of growing population.

As shown in the Table 5, nine States are projected to have 10 percent or larger gains in population during the first decade of the 21st century, which is more than double the U.S. average growth rate in the period of 5.3 percent. Seven of the nine States estimate that 30 percent or more of their wastewater treatment funding needs are required to meet this population growth. New Mexico, with growth needs representing 29 percent of the State's total needs, is very close to the 30 percent level. Of the nine, only Cali-

[13] **Wetrogan**, *Projections of the Population of States, by Age, Sex, and Race: 1988 to 2010*, **Table F, p. 6.**

TABLE 4. States Ranked by Wastewater Growth

State	Growth Needs as % of Total	State	Growth Needs as % of Total
1 ALASKA	51.6	* 27 CALIFORNIA	19.6
2 UTAH	49.9	28 Minnesota	18.4
3 Idaho	47.6	29 [Montana]	17.4
4 ARIZONA	44.6	30 NEW HAMPSHIRE	17.0
5 HAWAII	42.9	31 COLORADO	16.8
6 Oklahoma	40.1	32 Maine	15.5
7 GEORGIA	38.9	33 [Wisconsin]	13.9
8 NEVADA	38.8	34 [Nebraska]	13.2
9 Tennessee	38.8	35 [West Virginia]	12.7
10 FLORIDA	35.6	36 [Pennsylvania]	12.5
11 SOUTH CAROLINA	35.5	37 [Ohio]	12.2
12 DELAWARE	35.4	38 Rhode Island	10.8
13 TEXAS	33.6	39 NEW JERSEY	10.7
14 Kansas	32.6	40 Connecticut	9.0
15 NORTH CAROLINA	32.6	41 [North Dakota]	8.8
16 Arkansas	30.5	42 New York	8.2
17 Alabama	30.0	43 [Indiana]	8.1
18 NEW MEXICO	29.2	44 South Dakota	6.9
19 Louisiana	28.2	45 Massachusetts	6.7
20 Mississippi	25.2	46 [Illinois]	6.6
21 [Kentucky]	24.0	47 [Michigan]	5.9
22 Oregon	22.9	48 MARYLAND	5.8
23 Missouri	21.9	49 [Wyoming]	5.6
24 VIRGINIA	21.1	50 Vermont	3.4
25 [Iowa]	20.9	51 Puerto Rico	1.4
26 WASHINGTON	20.2	52 [Dist. of Col.]	1.4

* Median

NOTE: States shown in all capital letters are projected to experience above-average population gains over the next 20 years. States shown in brackets are those projected to experience population decreases, according to Census Bureau reports. Table excludes Guam, American Samoa, Pacific Trust Territories and Virgin Islands.

fornia indicates that less than 20 percent of the State's funding needs are directed to growth. No rule of thumb exists which would indicate whether 20 percent, 30 percent, or some other percentage is adequate to meet growth needs in a State which projects more than 10 percent population growth.

The table reflects some unlikely correlations. For example, Maryland is one of 19 States for which above-average population gains are projected, yet less than 6 percent of the State's total funding needs are identified as relating to growth. A higher percentage would be expected in such a growth State. At the other extreme are Kentucky and Iowa, both of which are projected to lose population. The table shows, however, that both States estimate that more than 20 percent of their total wastewater treatment funding needs are directed towards growth. There is no obvious factor to explain the lack of better correlation in all States between projected population change and growth needs as a percentage of total funding needs.

In sum, a picture emerges by comparing population projections with States' plans for future wastewater treatment capacity. This picture suggests a certain fit. While not a rigorous analysis, the information implies that most of the States which are expected to experience significant population growth are preparing to meet the wastewater treatment needs of that increased population. Information in the EPA needs survey only reflects estimates of funding re-

TABLE 5. States' Wastewater Growth Funding Needs as Percentage of Total Needs, Ranked by Percent Projected Population Change (2000–2010)

State	Growth Needs as % of Total	% Change 2000–2010	State	Growth Needs as % of Total	% Change 2000–2010
1 HAWAII	42.9	15.9	26 Rhode Island	10.8	3.4
2 ARIZONA	44.6	15.2	27 Idaho	47.6	3.1
3 NEW MEXICO	29.2	14.2	28 Maine	15.5	2.9
4 NEVADA	38.8	13.9	29 Vermont	3.4	2.9
5 GEORGIA	38.9	13.7	30 Massachusetts	6.7	2.8
6 FLORIDA	35.6	13.7	31 Missouri	21.9	2.6
7 CALIFORNIA	19.6	11.5	32 Connecticut	9.0	2.5
8 ALASKA	51.6	11.4	33 Minnesota	18.4	2.0
9 TEXAS	33.6	10.2	34 Kansas	32.6	1.4
10 NEW HAMPSHIRE	17.0	9.2	35 South Dakota	6.9	1.1
11 UTAH	49.9	9.0	36 New York	8.2	0.9
12 NORTH CAROLINA	32.6	9.0	37 Louisiana	28.2	0.6
13 VIRGINIA	21.1	7.8	38 [Montana]	17.4	0.0
14 MARYLAND	5.8	7.8	39 [Wyoming]	5.6	−0.4
15 SOUTH CAROLINA	35.5	7.7	40 [Kentucky]	24.0	−0.6
16 DELAWARE	35.4	7.6	41 [Illinois]	6.6	−0.7
17 COLORADO	16.8	7.5	42 [Wisconsin]	13.9	−1.5
18 WASHINGTON	20.2	5.8	43 [Nebraska]	13.2	−1.7
19 Mississippi	25.2	5.2	44 [Indiana]	8.1	−1.7
20 NEW JERSEY	10.7	5.1	45 [Michigan]	5.9	−1.7
21 Alabama	30.0	4.5	46 [Ohio]	12.7	−2.2
22 Tennessee	38.8	4.4	47 [North Dakota]	8.8	−2.9
23 Oklahoma	40.1	4.0	48 [Pennsylvania]	12.5	−3.2
24 Oregon	22.9	4.0	49 [West Virginia]	12.7	−6.1
25 Arkansas	30.9	3.8	50 [Iowa]	20.9	−6.6

quirements, however, and does not answer the related policy question of how those funding needs will be met.

Changes in Funding Needs Over Time

EPA's most recent survey indicated that nationwide funding needs actually increased by approximately four percent from 1986 to 1988. While needs were reduced by $3.6 billion through grant awards and construction during this period and the number of operating facilities increased by about 185 to 24,153, the 1988 survey also identified 11,000 facilities with remaining needs (or seven percent more than the number reported in the 1986 survey). Moreover, other factors accounted for an increase of $5.9 billion in needs between the two surveys. These factors included revised planning and design of facilities resulting from new Federal and State requirements and newly identified need for facilities.

The increased needs identified in the 1988 survey reversed a trend seen in several previous surveys in which EPA reported decreased needs from one survey to the next. Between 1982 and 1986, total needs decreased by $55 billion (after accounting for inflation), but the decrease was reportedly due more to application of stringent documentation requirements than to construction which reduced the existing backlog of uncompleted facilities.

Of the $68 billion in remaining backlogged needs, Federal, State and local spending combined in recent years to average approximately $3.6 billion in annual outlays. Were that level of spending

to continue for 20 years, the currently identified $68 billion would theoretically be eliminated. This is unlikely to occur for several reasons, however. First, Federal involvement (which now represents two-thirds of government outlays) is scheduled to decrease annually and be phased out altogether after 1994. To maintain historical spending levels would require State and local governments to replace all Federal funds with their own resources after the phaseout is completed. Whether States will have the fiscal capacity to do so is unknown.

Another unknown factor is whether Congress will reverse or modify the scheduled 1994 phaseout. The desire to do so will undoubtedly conflict with continuing efforts to reduce spending and the Federal deficit. New sources of revenues (perhaps from fees or dedicated taxes) would presumably be required to fund Federal spending at levels consistent with recent history. The 102nd Congress may begin to address this issue in the context of reauthorizing the Clean Water Act, but the outcome of legislative action is difficult to predict at this time.

A final unknown in terms of cost estimates is the still not fully documented expense of meeting future Federal or State environmental requirements. For example, better estimates may become available of the costs of correcting combined sewer overflow (CSO) problems. EPA's estimate in the 1988 needs survey of $16 billion for this category included only projects that provided adequate documentation. Since then, many cities have refined their estimates for this wastewater project category, and some believe that the cost to control all CSO problems may be $85 billion, or more than five times greater than EPA's current estimate. Thus, investment needs may continue to increase, offsetting decreases that result from construction to address identified backlog needs.

Meeting Future Water Infrastructure Needs: Can We Get There from Here?

The ability of States to finance a possible $85 billion to correct combined sewer overflow problems in addition to funding the portion of $68 billion in identified wastewater treatment needs that remains after 1994 cannot be readily determined but is in doubt. Projects to correct combined sewer overflows and replace deteriorated existing sewers will be needed primarily in Great Lakes and Northeastern States that are projected to experience slow or no growth over the next two decades. General economic conditions in these regions may make it difficult for State and local governments to invest heavily in public works infrastructure.

Investment needs are not confined to wastewater facilities. New treatment requirements will result from EPA regulations under 1986 amendments to the Safe Drinking Water Act. New regulations will impose compliance burdens on public and private water systems over the next few years, necessitating capital investments to improve technology for treating drinking water contaminants. For example, filtration and disinfection of drinking water supplies will be required. Substantial investments are anticipated for this rule alone, since more than 10 percent of municipal water supplies currently are unfiltered, including urban areas such as Seattle and New York City. EPA has not estimated the full costs of complying

with the 1986 amendments, since regulations are being issued in groups over a several-year period. EPA's most recent proposal, including standards for 18 out of 83 contaminants for which contaminant limits are required under the 1986 amendments, estimates annual compliance costs that range from $87 million to $166 million, depending on provisions of the final regulation.

Implications for Policy

At issue, finally, is the question of what policy tools should be examined where population change is affecting water supply and wastewater treatment services. Demography has diverse policy implications for areas expecting continuing growth and those projected to decline in population. This section discusses the implications and two types of options for policymakers. One option is money: providing dollars for infrastructure facilities needed to respond to changing population conditions. A second type of option involves techniques to improve efficiency in delivering water and wastewater services.

Funding Options

One set of policy tools involves funding to pay for construction of new capital projects or projects to prolong the service lives of existing facilities.

Funding the Needs of Growth States

The Clean Water Act's financial assistance program represents the core of Federal policy regarding wastewater treatment infrastructure. Since 1972, Congress has appropriated $50 billion to aid in construction of facilities needed to achieve the minimum treatment levels required by the law and consequently contribute to the larger water quality objectives of the Act.

As noted previously, current funding policies embodied in the Act deemphasize funding of projects needed to meet growth needs. Despite that emphasis, backlogged and current funding needs to satisfy environmental mandates remain impressively large—$68 billion. This point suggests to many analysts that the general emphasis of Federal policy on achieving environmental needs first is appropriate and should continue.

On the other hand, Table 1 (showing the State-by-State allotment formula) indicates that at least some of the projected high-growth States, including Arizona, Nevada, and New Mexico, receive relatively small shares of total funding under the current statutory formula. Ten States currently receive the same minimum allotment, less than one-half of one percent of total appropriated funds. Three of these (Nevada, New Mexico, and Delaware) are projected to be high-growth States, while four others are projected to lose population (Wyoming, North Dakota, Montana, and the District of Columbia). Population projections suggest that States such as Arizona and New Mexico can anticipate population increases similar to those of large high-growth States, such as California or Florida. [14]

[14] Preliminary data from the 1990 Census indicate that Arizona's population grew by 33 percent since 1980 and Nevada's population increased by 49 percent. Vobejda, Barbara. "Census

Continued

Some adjustment of the formula to reflect changes in the smaller States might be in order. For example, the high-growth States could be allotted a larger share, while shares allotted to States in the minimum allotment group where population decreases are expected could be reduced slightly.

Funding Needs in States with Slow or No Growth

States with little or no population growth would require little or no investment in new water facilities (aside from that to service shifts in the location of population). Other questions derive, however, from recognizing that infrastructure needs continue beyond the capital construction phase of a public works project. States that are expected to decline in population or to grow only slightly have already invested significantly in wastewater systems. Maintaining those systems is necessary, even in the face of slow or no growth. Indeed, failure to invest in continued maintenance of the Nation's infrastructure systems is often cited as a principal cause of premature deterioration and breakdown of these facilities. Yet, the inability to pay for new capital construction or operation and maintenance can be a significant problem in areas with a declining tax base.

Current Federal wastewater policy is silent on operation and maintenance of facilities, unlike the case of other infrastructure categories such as surface transportation, for which a specified portion of Federal funds is dedicated to operation, maintenance, and repair of highways and bridges. It could be argued that, to protect previous investments, Federal policy should explicitly support operation and maintenance to extend the useful service life of wastewater systems.

Similarly, two categories of wastewater treatment projects which are not currently eligible for Federal assistance are most prevalent in the States and regions that are expected to lose population. These categories are (1) major replacement/rehabilitation of existing sewers that are structurally deteriorating and (2) correction of combined sewer overflows, resulting when a mixture of domestic wastes and stormwater in the same sewer line exceeds flow capacity and discharges raw wast[illegible] into a stream or other body of water. EPA's current estimate of funding needs for these categories is $20.1 billion ($16.4 billion for CSO projects plus $3.7 billion for sewer replacement). Funding needs for both categories center in the Great Lakes and Northeast regions where decreasing or slowly growing population and tax revenues will make it less likely that States alone will be able to afford such capital investments.

The most recent Clean Water Act amendments, enacted in 1987, provide for an end to the Federal role in wastewater treatment after 1994. However meritorious the case is for financial assistance, and however large the funding needs, the prospects for revising Federal policy and extending this program beyond 1994 must be viewed as limited while Federal budgetary pressures persist. Moreover, with this program currently scheduled to end soon, making changes to either the statutory allotment formula or project eligi-

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Quantifies Trouble in Heartland, Growth on the Coasts." *The Washington Post*, Sept. 3, 1990, p. A6.

bility criteria is likely to have little impact on States. The recent trend of transferring program and funding responsibility to States and localities will continue.

Water-Supply Infrastructure

In the area of municipal water supply, programs are spread over several agencies, yet they total less direct Federal spending than the EPA wastewater treatment program. Three agencies (the Farmers Home Administration, Appalachian Regional Commission, and Economic Development Administration) administer grant and loan programs which seek to improve municipal water supply facilities along with other infrastructure categories. Three other agencies (U.S. Army Corps of Engineers, Bureau of Reclamation, and the Department of Housing and Urban Development) manage programs in which improvement of local water facilities is only one of many purposes for which funds may be used. These programs have supported a number of policy goals, including increasing local economic development, increasing available local water supplies, and promoting efficient State and local water supply policies. [15]

Just as aging sewer lines are concerns for older wastewater treatment systems, a similar concern exists for some water supply systems. Some have argued that the Nation's water supply and conservation needs are priority problems that warrant attention. Thus, some persons advocate establishing a new program of Federal grants to assist utilities and municipalities in repairing or replacing deteriorating water supply and distribution pipes.

In recent years, Federal spending for water supply averaged approximately $785 million annually, or less than 20 percent of all public capital expenditures for water supply. [16] Traditionally, the bulk of water supply spending has been accomplished by State and local governments, plus private water suppliers, which serve about 16 percent of the U.S. population. Lacking a comprehensive national program or needs assessment effort, like the wastewater treatment program, it is difficult to assess demographic implications for Federal policy. Still, while some have advocated establishing a Federal role in constructing new systems and rehabilitating existing water supply and distribution facilities, new programs appear unlikely to emerge while deficit reduction pressures remain high on Congress' and the public's agenda.

If new capital programs are not feasible, other types of assistance might be provided. Grants and technical support could help municipalities and water and wastewater utilities in carrying out water audit and leak detection programs. In some areas, especially urban areas with sewer and water lines that are decades-old, the amount of leakage can be very large. For example, New York City appears to be experiencing an increase in water consumption, even though

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[15] U.S. Congressional Budget Office, *Financing Municipal Water Supply Systems*. Washington, 1987. 44 p.

[16] The Congressional Budget Office reports that annual public capital expenditures for water supply averaged approximately $3.9 billion in the 1970's. Ibid., pp. 8–9. By the middle of the 1980's, total capital spending had increased to $6 billion annually, yet the State and local share is now about 90 percent of the total. U.S. Congress. Office of Technology Assessment. *Rebuilding the Foundations: A Special Report on State and Local Public Works Financing and Management*. Washington, U.S. Government Printing Office, 1990. p. 23.

the city's population is decreasing. Leakage is a major factor in this apparent consumption. [17]

As a general model for audits and leak detection, the Department of Energy administers energy conservation programs that assist States, utilities, local governments and other institutions (schools and hospitals), and individuals. The mandates for these programs, enacted in response to energy supply emergencies in the 1970s, have recently been extended through fiscal year 1993 (P.L. 101-440).

Financing: Who Pays?

In the absence of Federal funding, the responsibility to pay for new infrastructure, maintain existing services, and rebuild aging facilities resides with State and local governments, and many are now implementing alternative financing mechanisms to address their capital needs. Options include establishment of loan programs, capitalized with grants from appropriated funds, to finance new or rebuilt facilities; use of development fees and impact fees to pay for new construction; establishment of special service districts or other taxing authorities that can generate revenues to repay the bonds and operational costs of constructing and operating facilities; and application of user fees to support operating activities.

A full discussion of these issues is beyond the scope of this report. [18] Still, it is worth noting that, when States and cities fund projects and activities, they have greater ability to determine policy and set priorities. Federal funding is often accompanied by conditions, mandates, or other policy "strings" which the Federal Government uses to achieve numerous policy objectives. In the absence of Federal funds, these types of policy levers generally are not available to Federal policymakers, and the ability to achieve a degree of consistency in planning (through cost-effectiveness guidelines, for example) is limited.

OTHER POLICY OPTIONS

Another set of policy tools involves more efficient management of water resources through pricing and conservation. Moving towards policies that use available water more efficiently can offer many benefits for water supply and wastewater treatment. On the water supply side, if user demand for treated water is reduced by conservation, savings will be realized in

- acquisition of raw water supply and storage systems,
- the operating expense of chemicals needed to purify or treat the water, and
- capital needed to expand central treatment facilities, at least by delaying if not eliminating need for additional plants, even where population growth is occurring or projected.

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[17] Fisher, Karen. "Water Supplies Evaporating?" *American City & County*, v. 102, June 1987. p. 34.

[18] For some additional discussion see, "Bridges, Pipes and Concrete: Creating the Will To Pay for Infrastructure." *Governing*, v. 2, no. 7, April 1989. pp. 29-35. Also see, U.S. Congress. Office of Technology Assessment. *Rebuilding the Foundations: A Special Report on State and Local Public Works Financing and Management*. Washington, U.S. Government Printing Office, 1990. 125 p.

On the wastewater treatment side, any reduction in the amount of water discharged into the sanitary sewer system also yields benefits in

- reduced wastewater pumping costs, an energy savings to the municipality or utility,
- extended hydraulic capacity of sewers,
- possible reduction in the size of wastewater conveyance systems, especially where new construction would be needed for growth, and
- reduced capital and operating costs by limiting or at least delaying the need for plant expansion and by saving on energy costs and chemical usage to operate the treatment plant.

Conservation efforts underway in several States illustrate responses to both water supply and wastewater concerns. Massachusetts exemplifies such actions. The State has adopted programs including leak detection and water and wastewater utility-rate reform to extend available supply from the reservoir which is the principal water source for much of the State. Recently it enacted legislation and plumbing-code changes to require water-saving plumbing fixtures throughout the State, as part of a comprehensive program addressing Boston's wastewater construction and treatment needs. New York City has taken similar steps under the threat of a State-imposed moratorium on sewer hookups to an overloaded wastewater treatment plan in Brooklyn. The City has agreed to install 600,000 water meters by 1998 as a step away from charging users flat rates, to expand water-main leak detection programs to reduce infiltration into the sewer system, to use water-saving devices, and to install locks on fire hydrants. [19]

Most experts agree that appropriate pricing is the single most important option that can affect water and wastewater treatment usage. When used in combination with other efforts (such as installation of meters to measure actual use and charge users accordingly), price can be used to motivate conservation. Analysts also agree that water and wastewater services have been underpriced historically, thus discouraging conservation. This underpricing has resulted in insufficient revenues to fund operation, maintenance, and improvement programs adequately and led to physical deterioration of many water supply and wastewater systems.

Water and wastewater services are generally inexpensive because water is plentiful in most parts of the world and because rate structures often were formulated before expensive infrastructure facilities were required. Such rate structures served the objective of maximizing usage of a treatment and distribution system already in place, but they do not reflect today's high marginal cost of service. Consumers view water supply and wastewater treatment as public services, similar to fire and police protection. Pricing systems often fail to cover the full cost of these services, including maintenance and capital improvement. Rather than charging prices according to the marginal (incremental) cost of the service, charges for water and wastewater services are frequently based on

[19] *Clean Water Report*, v. 28, no. 19, Sept. 18, 1990, p. 188.

average-cost, which economists hold causes misallocation of resources in the long run.

Further, many analysts believe that adoption of pricing changes by water and wastewater utilities has greatly lagged costing and pricing reforms in other utility sectors (energy and telecommunications, for example). Some of the delay is attributed to institutional rigidity and to implementation problems. [20] This is especially true in the case of municipally owned systems, where local elected officials frequently are responsible for setting rates and often are reluctant to support rate changes, regardless of the need. Most water and wastewater utilities establish rates based on traditional average-cost pricing, including flat rates (especially in unmetered areas) and various types of block rates. Under block rate arrangements, water use greater than a specified amount is divided into blocks, with each consecutive block priced at a different rate.

Where block rate structures are employed, declining block rates predominate and tend to reflect the large economies of scale exhibited by water and wastewater utilities. Under such arrangements, water use or wastewater flow greater than a specified amount is divided into blocks, with each successive block priced at a lower rate. This form of pricing was common when many utility systems were constructued and had substantial excess capacity. It discourages conservation, however.

Utilities that adopt alternative rate structures may move towards increasing (inverted) block rates, in which each succeeding block is priced at a higher rate per unit, or seasonal or peak rates, which enable the utilities to reflect the large investments in storage and treatment needed to meet peak demand. Research in different parts of the country confirms that increasing prices do result in reduced consumption. For example, officials in Orange County, Florida, adopted a water conservation surcharge in February 1987. Under this program, if residential water demand exceeds 15,000 gallons per month, a 50-percent premium is imposed. Initial data indicate that the surcharge program has reduced excess monthly demand from 11 to 25 percent within the county service areas. [21]

Investigations in Arizona also indicate that price and rate structure manipulation can achieve conservation. In 1977 the Tucson water department adopted an innovative inverted rate structure along with a seasonal (summer peak) surcharge to focus rate increases on single-family, high-use residential customers. Nine years' data indicate that, as a result, that class of customer has reduced water use by 5 to 8 percent, although overall water use increased due to steady growth in the number of customers using the system. Moreover, during the same period, other user classes which were not subject to inverted rates (large commercial and multifamily dwellings) did not conserve and actually increased their percentage of total system use. [22]

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[20] Mann, Patrick C. "Reform in Costing and Pricing Water." *Journal of the American Water Works Association*, v. 79, Mar. 1987, pp. 44–45.

[21] Briggs, Robert K., Jr. "Evaluating a Water Conservation Surcharge Program in Orange County, Florida." *Government Finance Review*, v. 5, Apr. 1989, 7–10.

[22] Cuthbert, Richard W. "Effectiveness of Conservation-Oriented Water Rates in Tucson." *Journal of the American Water Works Association*, v. 81, Mar. 1989, pp. 67–73.

Conservation alone, whether through utility pricing or government-mandated cutbacks on water usage, will seldom obviate the need for new water supply and wastewater treatment in areas experiencing population and economic growth. One current exception occurs in Colorado, however, a State projected to experience above average population growth over the next two decades. Controversy has centered on a project proposed to meet Denver's future water supply needs. Objections to the cost and environmental implications of the project recently led planners to adopt a series of conservation measures in place of the new reservoir's construction. Likewise, Congress has considered legislation to authorize increased Federal funding for a water resource development project in Utah (H.R. 3960 in the 101st Congress). As approved by the House of Representatives in 1990, the bill provided these funds under an arrangement in which local users would agree to adopt a water-conservation program that includes water metering and performance standards for plumbing products in new construction.

Policy options related to pricing and/or water and wastewater rates are not primarily a Federal responsibility. However, Congress and the Federal Government could encourage more systematic study of water utility rate making. A model for such action is the Public Utility Regulatory Policy Act of 1978 (PURPA, P.L. 95-617), in which Congress directed State regulatory authorities and nonregulated utilities to consider alternatives to traditional rate structures and adoption of regulatory standards, such as metering and providing information to consumers.[23] Congress could provide State and local authorities and nonregulated water and wastewater utilities with technical or financial support to assist in implementing such requirements. In addition, Congress could condition other types of Federal assistance (for example, Clean Water Act or other grants) on fulfilling a mandate to study rates and standards.

Conclusion

A 1988 EPA report examined the overall impact of recent and forthcoming environmental regulations on municipalities, including drinking water, wastewater treatment, and a number of others.[24] While not separating out costs or impacts for individual areas, this report observes that the smallest and largest of communities (those under 2,500 persons and those over 250,000) will experience the biggest increases in costs from additional regulations, both in terms of dollars per household and percent of household income. The largest cities will spend an additional 0.5 percent of gross household income on these services, and household expenditures may increase between 50 and 100 percent as a result. The percentage of household income devoted to such expenses will be less in larger communities, however, because household income tends to be higher, compared with smaller ones.

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[23] In 1982 the Supreme Court upheld the constitutionality of these provisions of PURPA, finding that the requirements did not exceed Congress' authority under the commerce clause and did not intrude on State sovereignty. PURPA did not require States and nonregulated utilities to adopt or implement regulatory changes, only to evaluate them. *Federal Energy Regulatory Commission v. Mississippi*, 456 U.S. 742 (1982).

[24] U.S. Environmental Protection Agency. *Municipalities, Small Business, and Agriculture: The Challenge of Meeting Environmental Responsibilities*. Washington, D.C., 1988. 1 vol.

EPA estimates that the smallest cities would experience the largest overall percentage increases in user charges and fees. Households in the smallest communities will spend an additional 0.7 percent of gross household income on environmental services, compared with 0.4 percent nationwide. User fees in one-fifth of the smallest cities may rise over 100 percent above 1988 levels by 1996.[25] In small communities, moreover, the drinking water and sewage treatment requirements account for the largest potential increases, in part because many larger systems have already made investments to comply with current and anticipated requirements.

As one example, EPA's most recent drinking water regulatory proposal estimates impacts on household costs. EPA projects that households served by large to very large water systems (those serving more than 3,300 persons) could be subject to water bill increases of as much as $320 per year. Small systems (those serving fewer than 500 persons) could experience annual water bills that increase by as much as $2,400, although the law permits EPA to grant small systems exemptions from some requirements, based on economics and other compelling factors.[26]

Demographic trends, which are likely to make some areas smaller and more rural and other areas larger and more urban, will similarly highlight the extremes of community size in terms of the ability to finance future wastewater treatment and water supply. As discussed elsewhere in this report, the rate of change may be slower over the next 20 years than in recent decades. Nevertheless, whether they foresee above-average growth or slow or no growth, areas of the country that are most populated and those that are least populated will face a common concern and above-average problems when it comes to paying for necessary infrastructure projects.

Appendix

Water Use and Wastewater Data

The most recent data on water use in the United States come from a 1988 U.S. Geological Survey (USGS) report.[27] Figure 1, based on the USGS report, illustrates patterns of water withdrawals in the United States (from surface and groundwater sources) for conveyance to public suppliers or for self-supply purposes, followed either by direct discharge or treatment for water quality purposes before return to a water supply source.

While focusing on the year 1985, the report compares data for that year with 1980 statistics and, to a limited extent, with data at five-year intervals going back to 1950. USGS reported that water withdrawals in 1985 from surface and groundwater in the United States were 399 billion gallons per day (Bgal/day) of fresh water and saline water, or 10 percent less than in 1980. Based on a 1985

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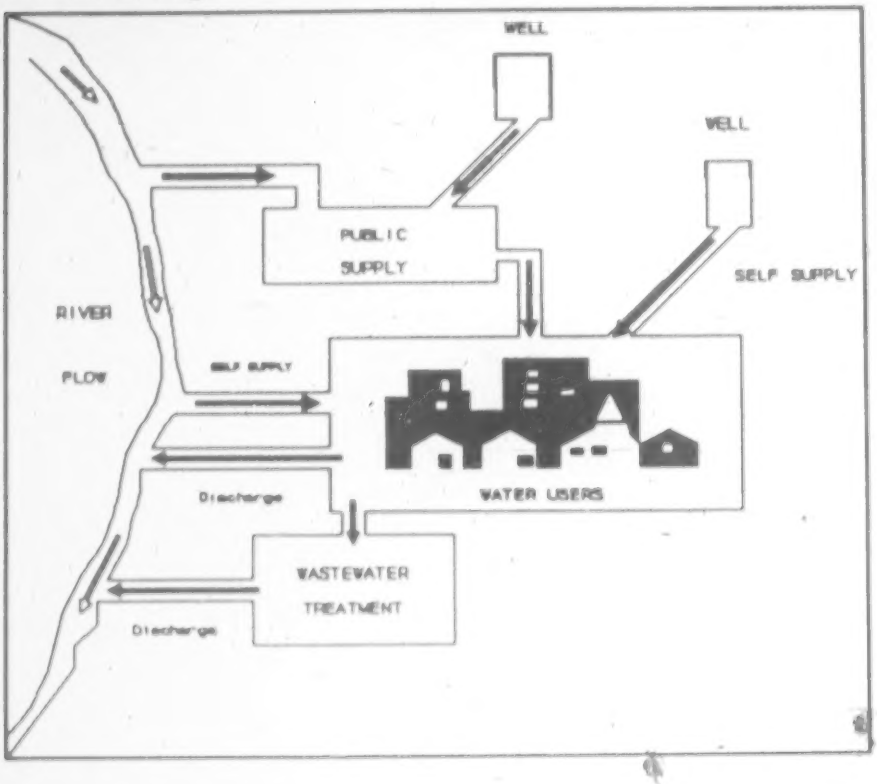
[25] Ibid., pp. 2-11–2-13.

[26] U.S. Environmental Protection Agency. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. *Federal Register*, vol. 45, no. 143, July 25, 1990, pp. 30370–30448.

[27] Solley, Wayne B., Charles F. Merk, and Robert R. Pierce. U.S. Department of the Interior, U.S. Geological Survey. *Estimated Use of Water in the United States in 1985*. U.S. Geological Survey Circular 1004. U.S. Government Printing Office, 1988. 82 p.

Figure 1. Schematic of Water Withdrawal, Use, and Discharge



population estimate of 242 million persons, average per capita offstream use was 1,650 gallons per day of fresh water and saline water combined. Offstream use involves water that is diverted or withdrawn from its source and is conveyed elsewhere for actual use. In 1985, public supplies accounted for 11 percent of withdrawals and deliveries for all offstream uses. Public supply is that portion of total water supply of greatest interest in terms of public works infrastructure. The remainder—nearly 90 percent of all water withdrawals—was self-supplied (by industry and agriculture, for example) and not obtained from public supplies.

Consumptive use refers to water which is depleted or consumed, or is not returned directly to any surface or groundwater source. According to USGS, consumptive use totaled 28 percent of all fresh water withdrawals in 1985, representing a 9 percent decrease in consumptive use between 1980 and 1985. The decrease in total withdrawals and consumptive use in 1985, compared with 1980, confirms a general trend that also occurred between 1970 and 1975 and between 1975 and 1980. However, some of the indicated decrease, according to the report, may be attributed to better estimating techniques.

In 1985, public water supply systems delivered 36.5 Bgal/day of water in the United States, or 7 percent more than in 1980. These deliveries were distributed to several categories of users: domestic (57 percent of public supply deliveries), industrial (16 percent), commercial (also 16 percent), and thermoelectric (less than 1 percent). The remaining 11 percent includes losses in the collection and distribution systems and public uses. Counting the public use purposes, public supply deliveries averaged 183 gallons per day per capita, unchanged from 1980. Per-capita household use (indoor and outdoor) averaged 100.2 gallons per day in 1985, according to USGS.

Public suppliers delivered domestic water supply to 83 percent of the U.S. population in 1985. Local municipal systems provided public water supply to 67 percent of the population, and investor-owned systems served 16 percent of the population. The remainder, approximately 42.5 million persons, was served by individual water systems, primarily in nonurban areas.

Centralized wastewater treatment systems today collect and treat 29 Bgal/day of wastewater (or sewage) from households and commercial, industrial, institutional, and recreational facilities, serving 71 percent of the U.S. population. By the year 2008, publicly owned treatment works (POTWs) now built or designed will serve 248 million persons, or 88 percent of the projected population, from facilities with design capacity of 55 Bgal/day. The population not served by centralized POTWs generally relies on on-site wastewater disposal systems that are not considered part of the public works infrastructure.

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